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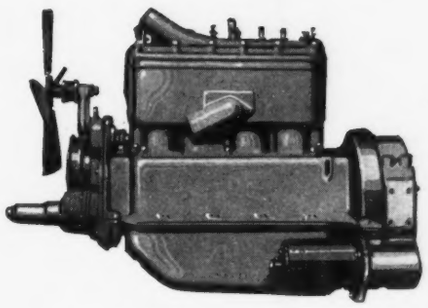
Where

Is the Largest Group of Automobile Buyers?



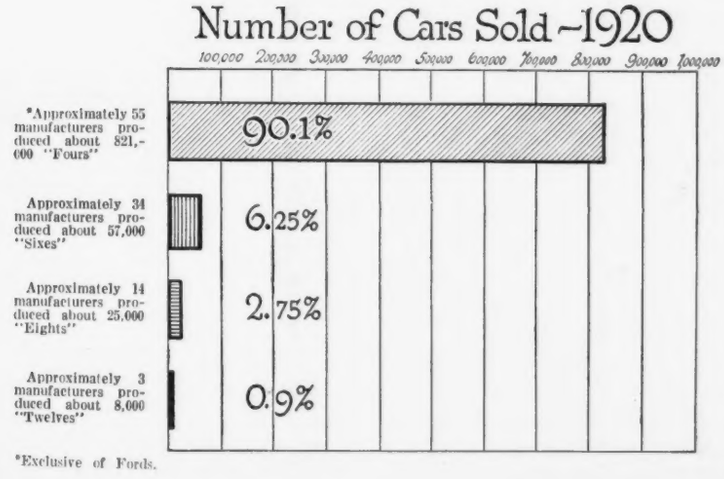
Model "K," Lycoming Motor

The group which constitutes the biggest market for automobiles is to be found among the more than 3,000,000 people whose incomes range between $2,000 and $10.000.

Obviously, price is an important factor of choice with the buyers in this group, as is evident from the chart which shows 90% of all cars sold are "Fours," which type predominates among the low and moderate price cars.

In this big market the Lycoming Motor has a unique place as an equipment asset for both car manufacturer and car owner. A simple, dependable "Four," made in one type and model only, it provides a power plant capable of doing anything that any motor can do and yet leaves a wider margin for balancing body and chassis value to enhance riding comfort and economy, than could be secured under the added expense of more cylinders.

A booklet describes the Lycoming Motor. Write for it.


Number of Cars Sold—1920
100,000 200,000 300,000 400,000 500,000 600,000 700,000 800,000 900,000 1,000,000
*Approximately 55 manufacturers produced about 821,000 "Fours"
90.1%
Approximately 34 manufacturers produced about 57,000 "Sixes"
6.25%
Approximately 14 manufacturers produced about 25,000 "Eights"
2.75%
Approximately 3 manufacturers produced about 8,000 "Twelves"
0.9%
*Exclusive of Fords.

Lycoming Motors Corporation

Williamsport, Pa.

Entered as second-class matter Jan. 2, 1908, at the post office at New York, N. Y., under the Act of March 3, 1879.

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AUTOMOTIVE INDUSTRIES
The AUTOMOBILE

VOL. XLV NEW YORK—THURSDAY, JULY 7, 1921 No. 1

What the New Tariff Bill Means to the Automotive Industry

Authority for Negotiation of Bargaining Tariff Treaties Opens Way for Better Export Conditions and Special Clause in Automotive Section Recognizes Industry as Leader in Foreign Trade. Aluminum Figure a Disappointment.

By Clyde Jennings

THE clauses in the new tariff bill which expressly permit the President to negotiate bargaining tariff treaties promise more for the automotive exporter than he has ever been able to see in any previous legislation of this kind. The fact that one of these clauses is in the automotive section of the bill sets aside all doubt as to whether the members of Congress engaged in drafting this bill had a proper appreciation of the importance of the automotive vehicle as export merchandise.

The bargaining tariff feature will enable the seller of American goods to capitalize the import consumption of this country to lower the price of his wares in a foreign country. We have, in this country, a very large consumption ability for Jamaica bananas. Jamaica has a relative consumption possibility for American automotive vehicles. If Jamaica wants cheap automobiles, then they must permit us to have cheap bananas.

The working of this sort of a tariff situation is illustrated differently in connection with the treaty clause in the automotive section of the bill. The bill sets the import duty at 25 per cent American valuation for foreign cars. France to-day imposes a duty at 45 per cent on American cars. The President is authorized to negotiate a treaty whereby each country will admit the other's automotive vehicles on the 25 per cent basis. In case the other country refuses, the President can increase the import duty on vehicles from that country to a maximum of 50 per cent ad valorem.

The proposal for a reduction of the American import duty from the present 45 per cent to 30 per cent was made by the National Automobile Chamber of Commerce some months ago and created much surprise in Congress, where practically all industries were asking for more protection. Indeed, some congressmen advised the automotive manufacturers that they were making a mistake, that Europe with its cheap labor would be flooding this country with cheap motor cars. The American manufacturers, however, assured Congress that they were unafraid and were ready to meet competition in this country or any part of the world, and with a lower tariff they believed that they would gain more than they would lose.

So the reduction has been written into the bill, the figure being 5 per cent lower than that the industry asked. This, however, is equalized by the change of valuation basis. Formerly the tariff was imposed on the European valuation. Under the present bill it is imposed on the American valuation, which includes freight, insurance and various other expenses which go to make the cost to the sales agent in this country. The result is that the 25 per cent in the Fordney bill

is equal to practically 31 per cent under the law it is proposed that this bill will succeed.

The National Automobile Chamber of Commerce has prepared the following summary of the points in the new tariff bill:

1. The following points of particular interest to the automotive industry are contained in the first committee print of the tariff bill, made public by the Ways and Means Committee of the House, Wednesday.
2. The import duty on all automobiles, bodies, chassis and parts, not including tires, is decreased to 25% of American valuation. The duty under the Underwood Act was based on the lower foreign valuation. When a foreign manufacturing country imposes a higher duty for such imports, duties here may be similarly increased, not to exceed 50% ad valorem.
3. Under special provisions, the President is empowered and directed to meet any import duties levied by other countries which he may deem to be reciprocally unequal and unreasonable, by suspending similar schedules here and levying such additional duties as he may deem necessary to equalize such rates.
4. The duty on aluminum, aluminum scrap, and alloys of any kind in which aluminum is the component part of chief value, is increased from 2 cents per pound to 5 cents. Request of the aluminum producer was for 7 cent tariff.
5. Crude oil and fuel oil are listed for duty of 35 and 25 cents per barrel respectively.
6. Motor vehicles sold for war purposes on which the U. S. internal taxes were not paid, would be subject to a duty equal to those taxes upon reimportation into U. S.
7. Assurance has been given that a resolution will shortly be introduced in the House which may provide duty as high as 300% on reimported war material of American manufacture; such procedure would afford protection at earlier date than tariff.

The disappointment in the bill, as set forth in this statement, is chiefly contained in paragraph 4, regarding the duty on aluminum. The automotive industry opposed by argument and otherwise the increase of this duty, but they did not press the point as strongly as some other industries. The automotive industry has at all times taken the position that it is necessary to have some taxes that will contribute toward the support of the Government, and aluminum is one of these.

The oil tariff, as set forth in paragraph 5, is higher than the automotive industry would like to have it. The same reasoning that applies in the previous paragraph applies here, with the additional circumstances that the oil industry is an industry of its own and that the various currents of influence in this reach very deeply into politics and finance, so that the automotive industry cannot object to duties that are satisfactory to those chiefly concerned. It was thought that if a tariff was left on oil there might be a less disposition to put domestic taxes on motor fuel.

Paragraphs 6 and 7 refer to the reimportation of automotive vehicles and other materials sold abroad for war purposes and many of which are now being returned to this country by speculators who have purchased them abroad.

In the tariff bill is a clause which would impose upon these goods all of the domestic taxes which they escaped because of being sold for war purposes. This would remove a part of the present unfair competition conditions. It would mean that before a vehicle could be sold as a used vehicle the tax equal to the sales tax on a new vehicle must be paid.

The Graham resolution, which is referred to in paragraph 7, would practically prohibit the return of this material to this country. It would provide an import duty as high as 300 per cent of this merchandise. This resolution is independent of the regular tariff bill and, from present prospects, seems very likely to be passed by both houses.

The favorable action upon the requests of the automotive industry by the congressional committees engaged in the drafting of the tariff would appear to be a subject for congratulation to those who represented the industry before these committees. The chief spokesmen were George M. Graham and C. C. Hanch. Their appearance before the committees was staged by Alfred Reeves of the National Automobile Chamber of Commerce and his staff. It has been the subject of comment in Washington that the automotive industry has made an excellent impression there by its give-and-take attitude and the ingenuity of its appeal.

Visual Inspection of Combustion

IN the development of the internal-combustion engine visual observation of the combustion has played a minor role. To be sure, early investigators did provide apparatus that permitted them to look in the cylinder while the engine was operating, but little has been done in this direction with engines operating at the high speeds of the present day automobile types. Interest has centered in what an engine could do rather than how it did it.

At the present time the cry for fuel conservation has reawakened interest in the nature of the combustion in the cylinder. Glass induction systems have disclosed how unsatisfactorily the fuel has been prepared for combustion. Analyses of the exhaust gases have shown how incompletely the charge has been burned.

This has been accomplished in connection with the study of combustion in the one-cylinder Liberty engine at the Bureau of Standards in the following manner: A spark-plug shell has been adapted to receive a circular section of glass intended to serve as a window in the cylinder. This assembly can be used in place of either spark-plug in the ordinary aviation cylinder, but in this instance an additional boss has been welded to the cylinder in order that conditions might be observed with both plugs firing. Its use was satisfactory in that changes in flame color due to changes in air-fuel ratio were easily discovered. Since the entire combustion stroke is completed in one-sixteenth of a second at an engine speed of 1800 r.p.m., it is possible to see only the predominant color by this means.

To make it possible to observe the combustion in its various stages a stroboscopic disk was added. Its purpose is to permit the combustion to be observed only a small portion of the stroke. Since there is one power stroke for every two revolutions of the crankshaft, this disk is driven at one-half crankshaft speed. The flame is observed through a slot in the disk, the length of the slot governing the length of the portion of the stroke studied. Provision is made for altering the angular relation of this slot to the crankshaft so that any interval of the cycle and, hence, any stage of combustion can be studied.

Observations made possible by this apparatus have proved of considerable value in research work of the nature described by permitting observations of the duration of luminous flame during the power stroke, the characteristic differences in color and brightness at different phases of combustion and their variation with changes in ignition timing, mixture ratio, compression pressure, etc. One observes, for instance, excessively bright flashes of flame of extremely short duration accompanying the phenomenon known as fuel knock or detonation. The cause for this phenomenon is of course not revealed.

Kansas Adopts Weight as Motor Vehicle License Basis

Cars are assessed on actual weight of vehicle, trucks on rated useful load capacity—More than 200 makes of vehicles licensed in state and some vehicles out of production for several years are listed in considerable number by State Secretary. 200 cars built by the present owner.

THE new license system for motor cars and trucks is in effect in Kansas. This system is based upon the weight of the car, or the carrying capacity of the truck. Licenses are being issued for the half year and beginning Jan. 1 the licenses will be issued for the full calendar year, bringing this state into line with most other states.

The license fee is $8 for cars of less than one ton gross weight, with 50 cents added for each 100 pounds above one ton. Cars of the Ford class take the minimum fee. The fee for the Buick five passenger car is $13. All of the money paid by the motorists for licenses, except 50 cents, goes into the road fund of the county where the car is owned. The 50 cents is taken for the administration of the law.

At the close of the old license year, June 30, there were 287,384 motor cars and trucks in the state, against a registration of 265,396 a year ago. There were 2166 dealers registered separately. This is a loss of 78 dealers from the registrations of the previous year. There were 3398 motorcycles registered and 34 dealers, while a year before there were 4220 motorcycles and 42 dealers.

There were 19,460 trucks registered during the past fiscal year. Heretofore the truck has paid the same license fee as a passenger car. The new license fee for trucks starts at $15 a year for trucks of less than one ton carrying capacity and gradually increases up to $100 a year for trucks of five tons or more.

On the basis of the population in March, Kansas has a car for every 6.19 persons in the state.

There are more than 200 makes of cars and trucks operated in the state. The Secretary of State listed 183 makes of cars and trucks and then had 597 cars of nondescript or obsolete manufacture. There are nearly 200 cars operated in Kansas under the name of the owner and builder. These builders have taken parts from several wrecked or fire damaged cars and have constructed themselves a motor car that runs and gets them to where they want to go. The railroads and express companies frequently hold sales of motor parts which are purchased by practical mechanics and built into cars. The speediest car making the Kansas racing circuit this year is built with two motorcycle engines, a Ford chassis and the wire wheels from a Saxon. It is chain driven and the chain was manufactured from pieces of old starter chains. Such cars as this are listed under the name of the owner.

Now the least interesting information in this report is the number of orphan cars in use in this great farming state. It will be noted that a considerable number of the cars made by companies which quit production in the slump of 1912 and 1913 are still in use and in some cases there are more of the old cars than the recent ones of the same class on behalf of which an active sales campaign has been waged. This information is only occasionally available from the official records of the registration bureaus of the states.

The following is a list of makes of cars and trucks prepared by the Secretary of State, one * indicating a truck, while two ** indicate both trucks and passenger cars are included in the figure given:

Abbot Detroit	28	Courier	2	*G. M. C.	340	Lexington	274	**Overland	19,780	*Service	61
*Acme	26	*Dart	21	*Gram Berstein	36	Liberty	236			*Smith	23
Allen	950	Davis	38	**Grant	1,162	Little	26	**Packard	289	Speedwell	14
*American	49	*Denby	35	Great Western	5	Locomobile	26	Paige	1,566	Stafford	50
Anderson	67	Detroit	218			Lozier	27	**Paige Detroit	10	Stanley Steamer	17
Apperson	370	Detroiter	44	Halloday	13			*Panhard	71	Stearns Knight	87
*Argo	8	Dodge	15,777	Haynes	792	*Mack	22	Parry	3	Stephens	193
Auburn	649	*Dorris	21	Harroun	138	Maibohm	74	Partin Palmer	17	*Sterling	34
*Avery	13	Dort	2,442	Hercules	9	Marathon	9	Pathfinder	19	Stevens Duryea	47
		*Diamond	63	Herff Brooks	22	Marion	94	Patterson	78	Stewart	39
Baker	14	Dixie Flyer	36	Holmes	18	Marmon	317	Patriot	37	Stoddard Dayton	16
Beggs	81	*Douglas	30	Hollier	34	Mason	7	**Peerless	148	Studebaker	7,647
*Bethlehem	39			Hudson	3,047	*Master	117	Petrel	1	Stutz	190
Briscoe	1,649	Elcar	371	Hupmobile	1,565	Maxwell	11,175	**Pierce-Arrow	103		
Brush	12	Elco	5			Maytag	4	Pilot	60	Templar	31
**Buick	20,538	Elgin	428	Imperial	55	Mercer	44	Pratt	10	Thomas	4
Bush	38	Elmore	1	*Indiana	181	Metz	266	**Premier	144	*Traffic	154
		Empire	319	*International	977	Meteor	35	Pullman	237	Tulsa	110
Cadillac	1,466	Enger	15	Interstate	330	Michigan	27				
Carnation	10	Essex	1,169			Milburn	39	Rambler	70	**Velie	1,318
Carter	64	Everett	29	Jackson	323	Mitchell	893	Rauch Lang	47	*Vim	76
Case	449			Jeffrey	211	Moline	25	R. C. H.	28		
Chalmers	1652	*Federal	25	Jones	241	Monroe	187	Regal	345	Wahl	14
Chandler	1,064	Firestone	6	Jordan	55	Moon	187	**Reo	5,305	Ward	38
Chevrolet	13,361	**Ford	144,076	*Jumbo	31	Moore	21	Rock Falls	32	Warren	38
Cleveland	125	Franklin	291					Republic	1,018	Waverly Electric	8
Cole	371	*Fulton	48	Kelly	79	**Nash	2,165	R. & V. Knight	13	Wescott	79
Columbia	184			King	172	National	68	Sampson	132	**White	349
*Commerce	135	*Galloway	5	Kissell	207	New Era	19	*Sandow	32	*Wichita	19
Commonwealth	23	Gardner	161	Koehler	3			Sayres & Scovell	64	Wilcox	13
Cunningham	14	*Garford	45	Krit	91	Oakland	4,839	Saxon	1,709	Winton	95
Corliss	28	Gary	38			Ohio	21	Scripps Booth	369	Woods Electric	21
Cutting	5	Geronimo	42	Lambert	12	Oldsmobile	2,786	*Seldon	32		
Crow Elkhart	407	Glide	52			Olympian	14	Sellers	3	Miscellaneous	597

Trials of German Carbureters for Using Non-Volatile Fuels

Sixteen makes participate in competitive tests made partly on the road and partly on the laboratory testing stand. Two winning instruments are here described. Both of these are of simple design and easily adjusted.

By Benno R. Dierfeld

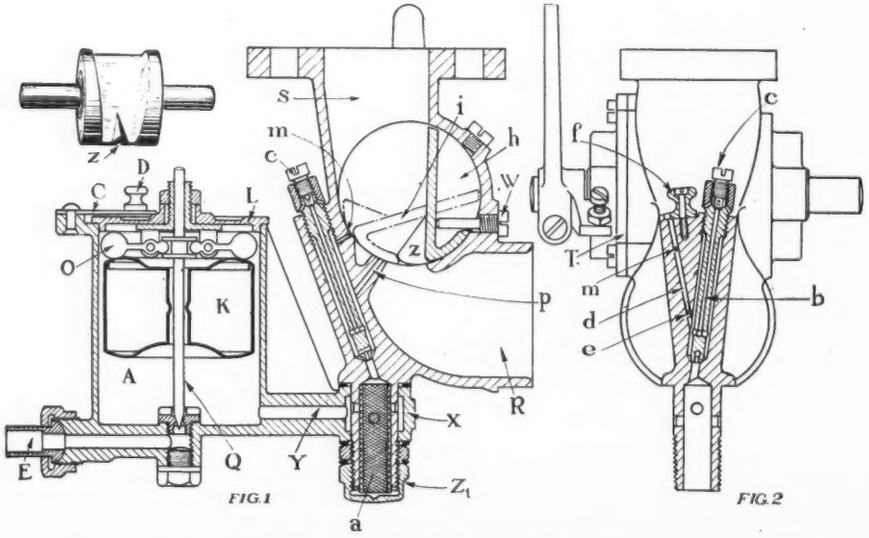
SOME time ago a national competition of carbureters for passenger cars and trucks was held in Germany under the auspices of the German Automobile Testing Committee and the largest German automobile club, the Allgemeiner Deutscher Automobil Club. As pointed out in a previous article by the author, fuels and fuel mixtures of very low volatility and generally of very different qualities are being used in Germany, and it was therefore considered a good plan to hold a contest to determine which carbureters were able to use these heavy fuels with the least trouble and in the most economical manner. With a good carbureter there should be little or no smoke at the exhaust, even with the heaviest fuels; the engine should start readily, should be flexible in operatiton and should give sufficient power. Furthermore, the carbureter should permit of changing from one fuel to another, as from a gasoline-alcohol to a benzol-kerosene mixture, without trouble and without requiring any great amount of adjustment. The results of the competition have just been published, and the winning carbureters undoubtedly come nearest meeting the present requirements, at least with the fuels available in Germany.

Sixteen different makes of carbureter participated in the competition, which was divided into three parts, a road test, a bench test and rating of the merits of design by the jury. The road test was held on a rather hilly course near Berlin and extended over a period of one week. The carbureters under test were fitted to 4½-ton trucks with 45 hp. engines. During the first two days a mixture of benzol and heavy oil was used for fuel; on the next two days a benzol-kerosene mixture and on the final day, for the sake of comparison, benzol alone. The heavy oil was gas oil, a product of petroleum distillation, with an end point of 680 deg. Fahr. The kerosene was not the ordinary lamp oil, but a heavier product obtained by the distillation of the heavy oil above mentioned.

A great deal of importance was attached to the road test, because the spark plugs were regularly examined as to fouling and the exhaust observed as regards smokiness, hence it was possible to check the character of the combustion. Emphasis should be laid on the fact that all the trucks ran with a practically clean exhaust. The engines were idled with the trucks standing and they were started up under different conditions, and all observations were noted. It was also observed whether or not it was necessary to change nozzles in the course of the contest, and if no exchange was made this was set down to the credit of the carbureter. The road test ended with a run up a 5 per cent incline ⅝ of a mile in length to test the pulling power of the engine.

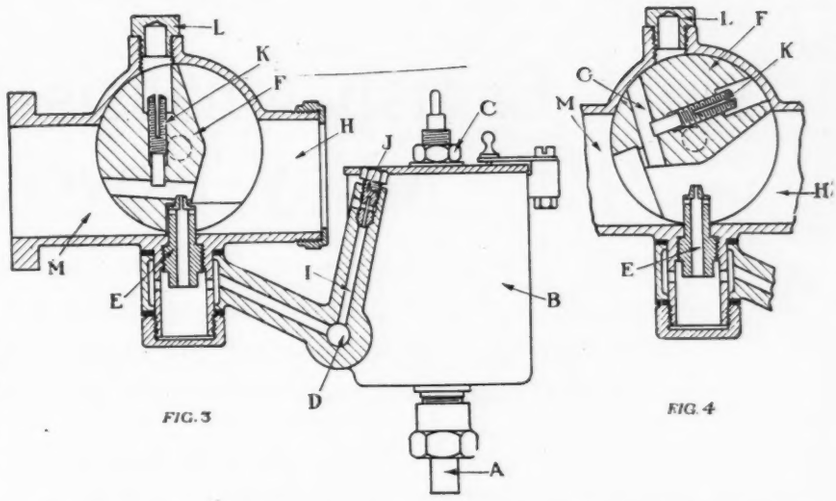
Bench tests were made at the automobile laboratory of the Dresden Technical University, under the direction of two professors. Owing to difficulties with the fuel supply, it was impossible to obtain the different grades of fuel which it had been intended to use for these tests, and a mixture of 30 per cent benzol and 70 per cent kerosene was used, the conclusion being reached that this poor fuel, in conjunction with the different fuels used during the road tests, would permit of fairly judging the qualities of the carbureters. Entrants were required to furnish one carbureter for each bench test of the series, and the carbureters were fitted in the presence of a representative of the entrant. No changes in the carbureters were permitted after delivery to the contest authorities, except replacements of venturi tubes and fuel nozzles during the preliminary tests.

The brake tests were made on a Daimler valve-in-head four-cylinder 4.14 x 5.90 in. truck engine developing 35 hp. at 1,000 r.p.m., and on an Audi L-head four-cylinder 2.95 x 4.65 in. passenger car engine, developing a maximum output of 22 hp. at 2200 r.p.m. A water brake was provided for the truck engine and an



Sectional views of the Homa carbureter, one of the winners in the German carbureter trials.

adjustable fan brake for the passenger car engine. The brake tests were divided into preliminary and main tests, and during each of these tests exhaust samples for analysis were taken and the spark plugs were examined. The preliminary tests served only to obtain the best possible adjustment of the carbureter and did not count in the results of the contest. The main tests included determination of the fuel consumption per horsepower-hour under wide open throttle condition at different engine speeds, determination of the fuel consumption per horsepower-hour at constant engine speed with gradually increasing load, determination of the lowest idling speed without change of carbureter nozzle, determination of the fuel consumption under these conditions and determination of the acceleration of the passenger car engine. Every test run had a duration of 10 minutes; then an exhaust gas sample was taken.



Two sectional views of the Einhorn carbureter which tied with the Homa in winning the German carbureter trials.

In the rating of design, points were allowed for different features, including special equipment, simplicity of design, low idling speed, lightness, accessibility of nozzle, etc. The preliminary work in connection with this part of the competition was done by experts selected by the jury. The jury consisted of ten members, including the leading carbureter experts of Germany. In making the awards, the results of the bench tests were given double weight as compared with the more practical road tests, one reason for this procedure being that in the bench test each carbureter was tested on two different engines. The result of the contest was a tie for first place between the Homa carbureter manufactured by the Homa Co. of Berlin-Halensee, and the Einhorn carbureter manufactured by the firm of Dehle & Severin, Gütersloh, Westphalia. The result was somewhat of a surprise, for the reason that the Einhorn carbureter was a newcomer and had been heard of very little before the trial.

Figs. 1 and 2 are two sectional views of the Homa carbureter, a make well known in Germany and widely used. Fuel enters the float chamber through tube E and the interchangeable seat of the float valve Q. Within the float chamber is located the conventional brass float K with balance levers O. The cover L of the float chamber is fixed in position by the knob D and flat spring C.

From the float chamber the fuel flows through passage Y to a hub X, by means of which the float chamber can be swung around into the most favorable position with respect to the engine. The lower part of the carbureter contains the fuel strainer a, which can be detached and cleaned after removing nut Z_1. The fuel from the float chamber passes through the single fuel nozzle b. This nozzle, which is rather long, has the fuel metering opening at its lower end and the calibrated correcting air nozzle c at its upper end.

The fuel enters the annular space between fuel nozzle b and the carbureter case, and fills up the main nozzle opening p leading to the throttle chamber. At the same time, however, the idling passage d (Fig. 2) provided with the calibrated bushing e, is filled with fuel up to a predetermined level. The throttle valve h with stop screw W is arranged in the usual manner and can be removed by detaching the cover plate T, but the throttle valve is of peculiar shape, having a nose Z on the regulating edge.

If the throttle is only slightly opened, as indicated in dotted lines in Fig. 1, then the main nozzle p is covered up, and during the suction stroke of the engine fuel is emitted only from the idling nozzle m, connecting the idling passage d with the throttle chamber, mixing with the high velocity air stream entering through the main air inlet R, thus producing a very rich mixture. Of course this fuel supply lasts only a short time. Thereafter air enters through the correcting air nozzle and no more pure fuel but a fuel fog consisting of little fuel and much air is sprayed through the idling nozzle m; in this manner the mixture is automatically weakened, while at the same time the fuel is thoroughly atomized at idling speeds. In the same measure as the throttle valve is opened, the main air entrance R and the main fuel nozzle are opened and regular operation begins.

The other prize-winning device, the Einhorn carbureter, is shown in the sectional views, Figs. 3 and 4, with the trottle valve in two different positions. Fuel passes through tube A to float chamber B, the fuel level of which is regulated by balance weights and a needle valve in the ordinary manner. The fuel level can be easily adjusted after removing nut C. The lid of the float chamber can be quickly detached in the same manner as in the Homa carbureter. From the float chamber the fuel flows to the calibrated nozzle D, and then to the atomizer E, detachable from below, provided at the top with one axial and several radial openings.

When idling, the throttle valve F occupies the position shown in Fig. 3. The top part of the atomizer E then projects into the passage G of the throttle valve F and fuel is drawn only through the axial opening of the atomizer. This fuel mixes in the passage G with the high-velocity air entering through main air inlet H, thus forming a rich mixture. After a short time the fuel in the idling passage I is exhausted and additional air enters through the correcting air nozzle J, whereupon a fuel fog is sprayed from the central opening of the atomizer E. In this manner the mixture is automatically weakened for normal operation, and yet the fuel is thoroughly atomized when running idle. The idle running screw K in the throttle valve F, accessible after removing the cap screw L, serves for the low-speed adjustment and is screwed in further if the mixture is too rich, and out if the mixture is too lean, a corresponding addition in the air being made by adjusting the stop screw of the throttle valve. If the throttle valve F is opened wide, then all radial openings of the atomizer E are uncovered in proportion to the area of the passage from the main air inlet H to the outlet opening M.

New British Chassis Incorporates Many Novelties

Leyland chassis has eight-cylinder-in-line engine possessing some unusual features. All chassis parts are lubricated from one central point. Other departures from conventional practice include vacuum-operated foot brake, twin bevel drive in rear axle and peculiar spring suspension.

By M. W. Bourdon

IN the number of its departures from standard practice it would be difficult to imagine any more pronounced than the new eight-cylinder-in-line Leyland, which is the product of the well-known British truck makers. Ignoring the arrangement of its cylinders, which are cast as a block with the top half of the crankcase, the overhead camshaft drive is an innovation. By skew gearing from the rear end of the crankshaft is driven a short longitudinal half-time shaft bearing three narrow eccentrics, and by means of three connecting rods, 16 in. long, coupled to these, and three similar eccentric disks at the rear end of the camshaft, the latter is rotated; the units of each group of three eccentrics are, of course, set at 120 deg. relative to each other. A costly job, but in that respect resembling many other features of this chassis, which is offered at approximately $12,000, with an output of eighteen planned for 1921 and 200 for 1922.

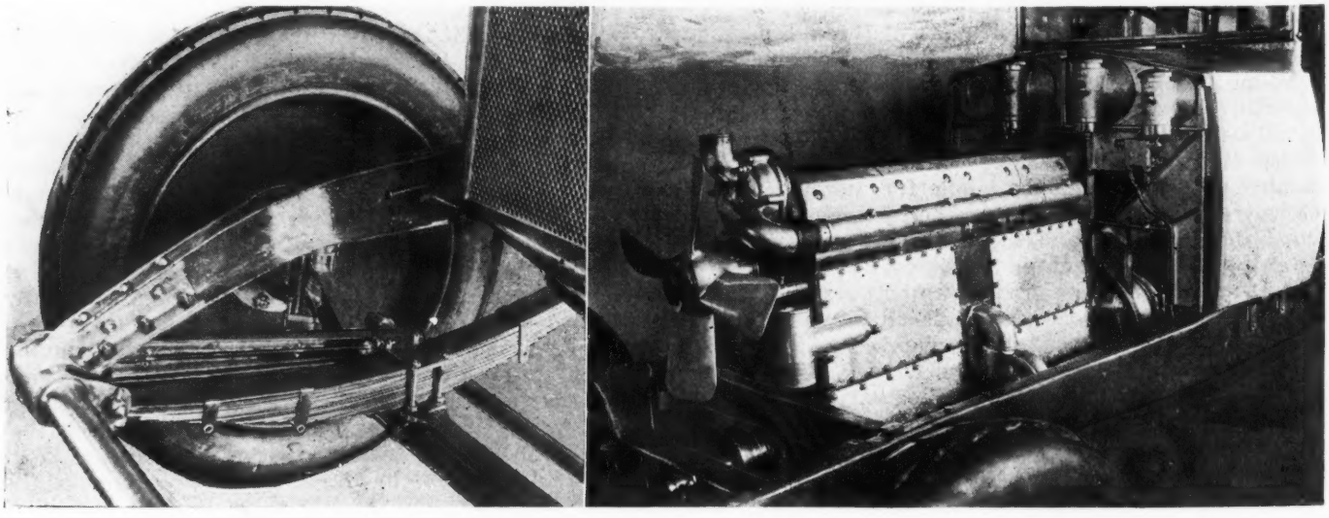
The overhead valves are operated by roller-end rockers and are held up to their seatings by flat steel laminated springs, each of the latter serving for the two valves of a cylinder and the longest leaves having slotted ends applying under T-headed studs screwing over the threaded valve stems. Each spring has 11 leaves, varying in length from one to six inches.

A dry sump system of engine lubrication is used, but the oil is picked up by the flywheel instead of by a second pump to return it to the rectangular aluminum tank at the side of the top half of the crankcase. A pump in the tank delivers the oil under pressure to the hollow crankshaft and to all parts of the chassis—following the lead of the Ferguson in the latter respect. A spare oil tank on the dashboard maintains a constant level in the engine tank, while another replenishes the gear-set. Alongside these is a 4-gallon vacuum tank usable for gravity feed with direct replenishment in emergency.

Water is circulated by pump with thermostatic control between radiator and engine—a feature of note being that the fan behind the honeycomb radiator is driven through a clutch which is thrown out of action at small throttle openings.

The steering column, with an excessive rake, finishes at the dashboard, to which the gear housing is attached; thence a vertical shaft with the steering lever at its lower end conveys the motion to the drag link. A single disk clutch and a flexible coupling carry the drive to the gear-set, the casing of which has a trunnion bearing at each end in U-glands, with square section leather packing, formed in the holes of two deep cross members. Except that the box is prevented from turning by two dowels or keys, it is free to "float" to accord with or counteract the effects of frame distortion.

The propeller shaft is divided, the front half being open and having two laminated steel joints, rectangular



Right—New eight-cylinder-in line Leyland engine. Overhead camshaft is driven by eccentrics. Fan clutch is disengaged automatically at low throttles. Four gallon gasoline tank and reserve oil tanks are set in dash
Left—Front spring suspension on new Leyland, showing radius member which is keyed to front cross-shaft enclosed by concentric tube. This shaft acts as a torsional spring and is intended to check rolling

plates connecting the star pieces instead of disks. The torque tube inclosing the rear half of the shaft is supported in a spherical housing in a cross-frame member.

A twin bevel drive occurs in the back axle, the differential being on the rear end of the propeller shaft. Straight-toothed bevels are used, while the driving shafts and the wheels are splayed.

Both brakes apply within the rear wheel drums, but the pedal-operated shoes are actuated by a vacuum device. Movement of the pedal allows engine suction to take effect upon a piston in a cylinder below the pedal, the latter having 5 in. of travel before the full braking effect occurs.

The suspension is distinctly out of the ordinary, for an endeavor has been made to prevent rolling by linking up the pairs of springs by torsion shafts. Thus at the front, where semi-elliptics are used, the spring ends are free to slide in brackets fore and aft. A steel drop forging of H-section forms a radius member at each side, extending from front extremity of frame to the axle. The fore ends of both links are keyed to a cross shaft inclosed by a concentric tube; thus when one spring is deflected, or when one is deflected more than the other, the cross coupling shaft is submitted to a torsional stress and yields to it, but acts as a flexible check. The shaft is approximately 1 in. (25 mm.) in diameter and is not intended, like the Wolseley Six cantilever rear spring coupling tube, to resist torsional stress and compel the opposite spring to check the one deflected.

At the back the Leyland has quarter-elliptic springs, to which the same principle is applied, but in this case the torsion shaft is secured to the butt ends, which have a trunnion bearing in a frame bracket.

The foregoing gives a general idea of the scheme for improving spring suspension; there are what the designer terms refinements, which do not affect the principle, but which cannot be described in a few words without drawings. Frankly, the writer must admit he is not impressed as to the advantages derivable. They may exist, but not, he suggests, to a degree which warrants the somewhat involved departure from normal practice. For example, one of the "refinements" referred to limits the total deflection of the springs, but, it would seem, to no better effect than a simple rubber buffer.

Detachable Fairleads for Aircraft

A FAIRLEAD, in aircraft construction, is a guide and support for the control cables connecting the pilot's levers with the flying control surfaces, or engine spark and throttle levers. Ordinarily these are metal tubes, brazed or soldered to a sheet metal clip for attachment to the aircraft structure, and threaded over the control cable. As such, the fairlead serves to hold the cable in line between pulleys, or to offset the lead to avoid interference with other parts, where the offset is insufficient to render a pulley advisable.

The Williams detachable fairlead, in addition to fulfilling the above functions, permits the cable to be removed or replaced at will. A single fairlead is shown in Fig. 1. It will be noted that the fairlead comprises a split composition guide held in a metal base, and locked in place by a wire. The method of operation is clearly shown.

Expansion of the number of guides held in a single base is readily possible, with retention of the detachable feature. A compound base, used for spark and throttle controls on a tandem engine installation is illustrated in Fig. 2. Following are the advantages claimed for this type of fairlead:

1—Control cables can be made up in production prior to the attachment of fairleads, and the fairleads attached to the aircraft structure during construction. 2—The composition guide presents a slow wearing, non-corrosive surface with inherent lubricating qualities to the control cables. Control cable wear is reduced, and in event of wear to the guides, replacement is readily accomplished. 3—Replacement of control cables is facilitated, and erection or tearing down the aircraft can be accomplished with a minimum of work. Replacement cables can be made up complete in the shop, thus avoiding leaving one end open to be made up at the field on assembly. 4—Light weight, standardization and low cost.

According to the inventor, S. T. Williams, of Philadelphia, in one installation where the detachable fairlead replaced an ordinary fairlead, cable life was increased from 18 hours flying time to over one hundred.

In a laboratory test, a fairlead was set up with a 6 in. cable offset in 3 ft., and under a 100 pound pull on a 7 in. stroke, 70 strokes per minute, ran for 75 hours without noticeable cable wear. No lubricant was used. The test was discontinued only because the cable was fraying where it passed over a pulley before going onto the fairlead. Though the fairlead was deeply grooved, it was still in condition for many more hours of service.

Ordinarily only two sizes of fairleads are required—one for flying control cables, and one for engine and accessory controls. These have been standardized for the single base mounting. When compound mountings are required, standardized guides are used.

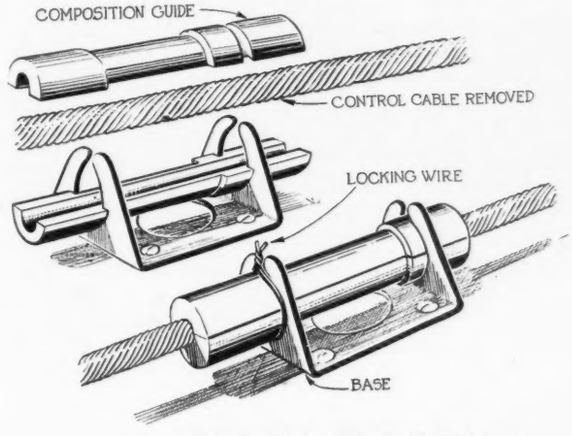


Fig. 1—Single Detachable Fairlead

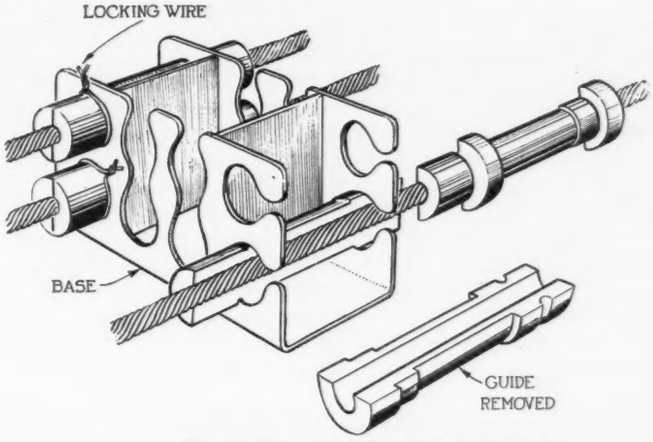


Fig. 2—Compound Detachable Fairlead

Influence of Various Fuels on Engine Performance

Part IV

When all fuels are used with same compression ratio power output is proportional to energy content of charge, but fuels which can be used with higher compression ratios without detonation are capable of developing higher maximum power than those which detonate at lower pressures.

By H. R. Ricardo*

THE power output obtainable from different fuels must be regarded from two points of view:

(1) When all fuels are used with the same compression ratio.

(2) When the compression is adjusted to suit each fuel, the ratio of compression being the highest consistent with freedom from detonations under any normal circumstances.

We will deal first with the results obtained at a constant compression ratio. Under these conditions, provided that each fuel is burned at the same efficiency (and it will be shown later that this is the case), the power output will clearly be proportional to the energy content of the fuel-air mixture. This energy content will be equal to the product of the heat of combustion of the fuel, when burnt with the requisite quantity of air, and the change in specific volume. By change in specific volume is meant the increase or decrease of the number of molecules in the working fluid during combustion. It is clearly necessary to take account of this in calculating the total internal energy of the burnt fuel-air mixture, since at the same temperature the pressure will be proportional to the number of molecules.

Heat of Combustion of a Fuel-Air Mixture

This is probably best expressed in terms of foot-pounds of heat energy liberated by the combustion of 1 cu. in. of a mixture of fuel and air measured at standard temperature and pressure, the mixture being in all cases of such proportions that all the oxygen in the air is combined.

As pointed out previously, the heat of combustion of a fuel-air mixture as defined above has no direct relation to the calorific value of the fuel.

Table VII gives the specific gravity, the calorific value in terms of weight and volume, also the heat of combustion of a number of different hydrocarbons, which form the principal ingredients of nearly all the available volatile hydrocarbon fuels and some other combustible substances.

From this table the heat of combustion of almost any volatile liquid fuel can be arrived at once its chemical composition has been determined.

The change in specific volume varies, of course, with the composition of the fuel; it varies also with the mixture strength. In the case of all fuels belonging to the general group known as petrol, the specific volume after combustion is substantially greater than before, thus giving a net increase in the total internal energy. In the case of benzol and other members of the aromatic group there is only a slight increase in specific volume, while in the case of hydrogen, carbon disulphide, acetylene, etc., there is a substantial decrease.

Table VII gives values for the following:

Column E.—The change in specific volume after combustion of a mixture of fuel and air in such proportion as to give complete combustion without excess of air.

Column F gives the total energy liberated by combustion in terms of foot-pounds per cubic inch, taking into account the change of specific volume, and again assuming that the proportions of the mixture are such as to give complete combustion. Column C of Table VIII may therefore be taken as an expression of the power output obtainable from each fuel, assuming:

(1) That the mixture strength is that giving complete combustion.

(2) That the fuel is completely vaporized before entering the cylinder.*

(3) That the temperature of the mixture after complete evaporation is the same for each fuel.

When an over-rich mixture is used, and the fuel is only partially burnt, the heat of combustion of the mixture will be no greater, but the increase in specific volume will in most cases be larger, and therefore the total internal energy will be somewhat greater on this score; therefore a slight increase in power might be expected in the case of those fuels having a relatively large increase in specific volume. On the other hand, when an over-rich mixture is used the products of combustion so formed have a higher specific heat, and this, in nearly every case, counteracts the advantage which would otherwise be obtained from the increase in specific volume. In practice, with, perhaps, the single exception of the alcohol group, very little, if any, increase in power is obtained by using a mixture richer than required for complete combustion.

*From a preliminary report on research work conducted by the author and other investigators for the Asiatic Petroleum Co. and published in *The Automobile Engineer*.

*NOTE.—This will only be true, strictly speaking, if Column D of Table VII is calculated using calorific values of the fuels burnt in a state of vapor. Bomb calorimeter experiments give calorific values from a liquid state, therefore to the usual calorimetric figures should be added the latent heats of evaporation. Strictly speaking, there should be added only the latent heat *at constant volume*, which is the usual latent heat (at constant pressure) less px (expansion on vaporization). This latent heat is apparently about $^{14}/_{15}$ of the figure at constant pressure. Latent heats are almost certainly observed at atmospheric pressure, so that the amount to be subtracted will be simply $\frac{14.7 \times 144}{778}$ (specific volume of vapor at normal B.P.).

An examination of Column F of Table VII reveals the very interesting fact confirmed by numberless experiments that the power output available from all known volatile hydrocarbon fuels is the same to within narrow limits provided (1) that they are all tested at a compression ratio at which full ignition advance can be used without detonation, and (2) that the losses due to change in specific heat and to dissociation at high temperatures are the same in all cases. In this connection Messrs. Tizard and Pye's investigations prove that there is very little to choose in this respect between the combustion mixtures of any of the available fuels.

The experimental results, a résumé of which will be given later, and which cover a very large number of independent tests, have completely borne out the conclusions arrived at from Messrs. Tizard and Pye's theoretical investigations of the chemical properties of the fuels and of the process of combustion. All the experiments have proved conclusively that, so long as the fuel is completely evaporated, the maximum power obtainable from samples of each of the groups given in the above tables, or from any combination of them, is proportional to the energy content, and, excepting only the alcohol group, is the same to within less than 3 per cent. The differences in the losses due to dissociation and to change of specific heat that do exist are such as to minimize the differences between the heats of combustion of the different types of fuels (paraffins, naphthenes, aromatics, etc.), and to place them still more nearly on a par.

There is, however, one variable factor which has been mentioned previously, and which, so far as the writer is aware, has not beer taken into consideration by other experimenters, namely, the influence of the latent heat of evaporation upon volumetric efficiency. This factor was found, in the case of alcohol and the other members of this group, to have a very powerful influence on the maximum power output obtainable.

The conclusions given so far are based on the assumption that the whole of the fuel is evaporated before its entry to the cylinder—in practice this is seldom, if ever, the case. It is, of course, clear that the weight of charge taken into the cylinder will depend upon and be inversely proportional to its absolute temperature at the moment when the inlet valve closes. There is definite evidence from experimental results that, with the exception of alcohol and the other members of its group, all fuels boiling below 200 deg. C. (392 deg. Fahr.) are completely evaporated before the commencement of the compression stroke by contact with the hot walls and admixture with the highly heated residual exhaust products in the cylinder excepting only a very small proportion which may enter the cylinder in coarse drops, and so not only escape evaporation, but even to a large extent combustion also. This proportion is, however, quite insignificant, and has no influence so far as power output is concerned.

The absolute temperature, therefore, at the commencement of the compression stroke is dependent upon (a) the amount of external heating applied, and (b) the latent heat of evaporation. It is almost independent of the temperature of the charge during its entry to the cylinder. In fact, the final absolute temperature, and, therefore, the weight of the charge taken into the cylinder is dependent upon the quantity and latent heat of the fuel, and upon the amount of heat added to it, external to the cylinder—it is substantially independent, either of the volatility of the fuel, or its entering temperature.

For example, a highly volatile fuel entering the cylinder at 0 deg. C., (32 deg. Fahr.), and a heavy fuel of low-vapor tension entering at 30 deg. C. (86 deg. Fahr.), will both have the same final absolute temperature at the commencement of compression, if the latent heat of both is the same, and if both charges received the same amount of pre-heating. In the former case most of the evaporation has taken place outside the cylinder, and the added heat has been absorbed by the latent heat of the vapor, in the latter case little or no evaporation has taken place outside the cylinder, and the added heat has therefore raised the temperature of the air and the still liquid fuel. In both cases contact and admixture with the highly heated exhaust products in the cylinder will complete evaporation, and in both cases the final temperature will be the same, hence the weight of working fluid (which is inversely proportional to the absolute temperature), and therefore the power output, will be the same in both cases.

From the above considerations it will be seen that, with any given amount of pre-heating (provided it is not excessive), the volumetric efficiency, and therefore the power output, will vary directly with the latent heat of the fuel.

The writer has deemed it advisable to emphasize this point very strongly, because he was at first misled into supposing that the final suction temperature was proportional to the inlet temperature, as it would be in the case of a gas engine. The above conclusions may be summed up as follows:

(1) The power output is inversely proportional to the absolute temperature of the working fluid at the end of the suction stroke—since it is the temperature at this point which controls the weight of charge, and therefore the volumetric efficiency.

(2) Other things being equal, the final suction temperature is controlled by the amount of external heating, on the one hand, and the latent heat of the fuel on the other; it is nearly independent of the temperature of the entering charge or its volatility.

Starting with a mixture of fuel and air at atmospheric temperature, heat is added by (a) contact with the inlet valve and hot walls of the cylinder, (b) admixture with the residual exhaust gases in the combustion chamber, and by (c) external heating of the carbureter or induction system. Heat is abstracted by (d) the latent heat of evaporation of the fuel; (a) and (b) may be regarded as constant, and, for the purpose of the present argument, may be ignored. For any given fuel, therefore, the power output obtainable is controlled primarily by the amount of heat added to the working fluid before it enters the cylinder, and, so far as power output is concerned, it is immaterial whether the heat so added is devoted to raising the temperature of the mixture or to evaporating the fuel at low temperature. Conversely with any given amount of pre-heating, the power output obtainable is dependent upon the latent heat of evaporation of the fuel.

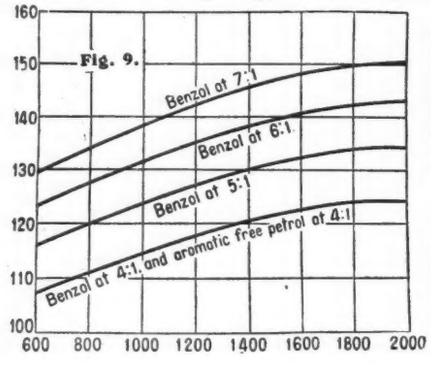
Apart from the alcohol group, the variation in latent heat is not very large, and does not exercise any appreciable influence. It is interesting to note, however, that in cases where the total internal energy is lower, the latent heat is generally slightly higher; consequently a slightly greater weight of charge is taken into the cylinder, sufficient in most cases to compensate for the lower internal energy, and thus bring the actual power output to substantially the same in all cases. This point is well illustrated by the instance of benzol, as will be seen at once by reference to Table VII. The energy liberated by combustion of a cubic inch (at standard temperature and pressure) of benzene-air mixture is appreciably lower that that of the hydrocarbons forming the greater proportion of gasolines. On the other hand, the latent heat of benzol is considerably greater, and as the result the power output obtainable from benzol is the same as that from gasoline to within less than half of 1 per cent.

Table VII gives the latent heat of evaporation of a num-

ber of hydrocarbons and other substances enumerated in the previous tables. The air-to-fuel ratio by weight, also the drop in temperature of the mixture due to evaporation of the liquid, is shown for each fuel. The calculations are made for mixtures giving complete combustion, but without excess of air.

In the case of alcohol, owing to the very much higher latent heat and to the fact that the proportion of fuel to air is also much greater, the latent heat of evaporation plays a supremely important part, and results in a really marked increase in power as compared with other fuels, although its total internal energy is lower than that of either gasoline or benzol. Moreover, there is introduced a feature which is not observed to any marked extent with other fuels—namely, that the power output increases very considerably when an over-rich mixture is used, because more fuel is then evaporated, the temperature of the charge is lowered, and the gain in weight of charge or volumetric efficiency considerably more than outweighs the loss due to the greater specific heat of the products of combustion.

Apart from the variations due to the differences in the latent heat of evaporation of fuels, which only assumes important proportions in the case of alcohol and the other members of that group, all tests proved that the power



Relation between indicated mean effective pressure and R.P.M. in the variable compression engine at different compression ratios with benzol and with aromatic free gasoline

NOTE.—The curve for aromatic free gasoline at 4:1 compression lies so close to that for benzol at the same compression it is not possible on this scale to show them separately.

output obtainable was, in fact, directly proportional to the total internal energy of the fuel, and this was further confirmed by the fact that the thermal efficiency at any given compression ratio was found to be the same with all fuels boiling below 200 deg. C. (392 deg. Fahr.), except the alcohol group. That is to say, it was found that each fuel was burnt at the same efficiency, and, therefore, the same proportion of its internal energy was converted into power. In the case of the alcohol group the efficiency was found to be slightly higher, and a further increase in power output was obtained thereby.

There was clear evidence that in the case of the alcohols, owing to the very high latent heat, evaporation continued throughout the compression stroke also, with the result that the compression was nearly isothermal. As a result the temperature of the cycle was lowered, the losses due to conduction and to change of specific heat were reduced, and the efficiency was slightly increased thereby. This feature became particularly prominent in the case of methyl alcohol, which has the highest latent heat of any of the fuels tested, and since it has also the lowest calorific value it follows that the weight of fuel per cycle is greater than with any of the others. Both the power output and efficiency obtainable with methyl alcohol were considerably greater than with any other fuel examined.

In referring to alcohol and allied substances as fuels it should perhaps here be explained that though these fuels give a considerably greater maximum power output, and, furthermore, can be used with a higher thermodynamic efficiency than either gasoline or benzol, the heat value of the alcohols per unit of weight or per unit of volume of the liquid is so much lower than that of gasoline or benzol that the rate of consumption for equal power output is nevertheless greater. The exact amount of this larger fuel consumption with alcohol, as compared with gasoline or benzol, will be examined later when dealing with the subject of efficiency.

In Table VII is given (Column J) values for relative power output calculated directly from the foregoing tables and in accordance with the argument adduced above in arriving at the conditions governing power output. As will be seen by a glance at this table, the greatest difference among the paraffins, aromatics and naphthenes is hardly more than $\pm$ ½ per cent. This deduction, as will be seen later, is corroborated almost exactly by the experimental results.

With a view to determining definitely the power output obtainable from each fuel at the same compression ratio, several hundreds of tests were run both on the variable-compression engine and on the supercharging engine. In all cases the procedure adopted was as follows:

A suitable compression ratio was chosen at which it was known that none of the fuels to be tested would detonate under any conditions of mixture strength or ignition advance. The engine was first started up either on the specially prepared aromatic free gasoline, or on pure benzol, which was adopted as the standard fuel for high-compression work. It was then run with wide-open throttle at a speed of 1,500 r.p.m. until the temperature of the jacket water, carbureter, lubricating oil, and induction pipe had settled down to constant values.

The best ignition setting and mixture strength for the development of maximum power on the fuel were, of course, well known from previous experience, but no readings were recorded unless or until the torque was within $\pm$ 0.3 per cent of that known to be obtainable with the standard fuel (after correction for barometer).

So soon as the running conditions were considered to be in every respect normal, and the engine was found to be developing standard power with standard settings, the fuel was changed over to the sample to be tested; the correct mixture strength and ignition setting for the development of maximum power with the new fuel were found, and readings of torque were taken. In some cases the torque curve over a wide range of speed, generally from 800 r.p.m. to 1800 r.p.m., was explored, but this practice was discontinued later after it had been found from repeated experiments that the characteristic of the torque curve over the whole available range of speed was the same for every fuel tested (provided, of course, that the correct mixture strength and ignition setting was used for each speed).

The maximum power output obtainable from each sample of fuel was determined in this manner, the time taken to find the best settings and secure steady and reliable readings being about half an hour in each case.

During the whole period of such a series of tests the throttle remained wide open, and great care was taken to prevent any variation in temperature either of the circulating water or the heat input to the carbureter.

After completing a series of such tests on a number of different samples, a final test was always made on the standard fuel, when, with the same temperatures throughout, and the original adjustments for this fuel, the power output had to return to within less than 0.5 per cent of the initial reading, or the tests were discarded as unreliable. In such tests only one variable remained, namely, the temperature of the lubricating oil, which always rose slightly during a prolonged run of the nature just described. In the case of the variable-compression engine, owing to the extensive use of ball bearings and

other precautions, the oil temperature had no appreciable influence on the performance of the engine, but in the case of the supercharging engine the friction losses diminished perceptibly as the oil temperature rose, and a small correction seldom exceeding 0.4 per cent had to be made for this factor. Great care was, of course, taken to ensure against any variation in the character of the oil supplied. A large stock of lubricating oil was prepared and set aside for the purpose of these tests in order to ensure uniformity throughout.

At the conclusion of each series of tests the engine was motored by means of the balanced electric dynamometer in order to check the mechanical losses.

For the sake of uniformity all figures are given in terms of indicated horsepower, indicated thermal efficiency, etc. This was found desirable because of the differences in mechanical efficiency between the several engines upon which the tests were carried out. The mechanical losses of the engines used were ascertained very carefully by both direct and indirect measurements, and, once determined, and variation could be detected at once by the motoring test. In the case of the variable-compression engine no measurable change occurred after the first thirty or forty hours' running, but in the case of the supercharging engine slight variations in friction were noted from time to time, due probably to slight distortion or lack of rigidity in the structure of the engine.

The power tests at constant compression were run under three different conditions, namely:

(1) With no heat supplied to the carbureter.

(2) With a constant heat supply of 65 B.t.u. per minute when running at 1500 r.p.m., or 0.0433 B.t.u. per minute per revolution per minute when running at speeds other than 1500 r.p.m.

(3) With the heat supply varied to maintain the entering gases at a constant temperature of 15 deg. C. (59 deg. Fahr.) as measured* by a thermometer in the induction pipe and close to the inlet valve.

In Table VIII is given the mean results of a very large number of tests taken on the variable-compression engine, with the different temperature conditions referred to above.

Since in this table are given actual experimental results, the fuels enumerated are of necessity only those of which fairly large quantities could be obtained—very few chemically-pure hydrocarbons are obtainable in any quantity. The substances given here are the same as those included in Table II.

In view of the fact that in most engines the heat supply to the carbureter may be regarded as more or less constant, the results obtained under the conditions shown in Columns F and H are the most important and the most nearly allied to practice. The results shown in Columns G, I and K are interesting in that they give an indication of the volatility of the fuels.

In this table, Columns B, C and D show the approxi-

*The figures given for the temperature of the working fluid as it enters the cylinder must be regarded as a first approximation, and are only strictly accurate when the whole of the fuel is evaporated before it reaches the thermometer bulb. There can be little doubt that when unevaporated fuel is present the thermometer acts as a "wet bulb" thermometer, and therefore gives readings which are below the true value. No means have yet been found for measuring accurately the temperature of the working fluid when a portion of the fuel is unevaporated. As explained previously, the actual temperature of the working fluid during its entry to the cylinder is relatively unimportant, for it is the total heat input which controls the volumetric efficiency, and therefore the power developed.

TABLE VII

Name of Fuel	A	B	C	D	E	F	G	H	I	J
	Specific Gravity at 15° C. (59 Deg. Fahr.)	Calorific Values (Lower Values, Not Including Latent Heat of Evaporation)		Heat of Combustion in Ft. Lb. per Std. Cu. In. of Mixture Giving Complete Combustion	Change in Specific Volume, *i.e.*, Sp. Vol. after Combustion ÷ Sp. Vol. before Combustion	Total Energy Liberated by Combustion, Ft. Lb. per Std. Cu. In.	Latent Heat of Evaporation B.t.u. per Lb.	Air to Fuel Ratio (by Weight) for just Complete Combustion	Fall in Temperature of Mixture Due to Latent Heat of Evaporation, Deg. C.	Relative Power Output Allowing for Increase in Density Due to Evaporation Octane = 100
		B.t.u. per Lb.	B.t.u. per U. S. Gal.							
Paraffin Series.										
Hexane	0.670	19,410	108,300	45.9	1.053	48.33	156	15.2	21.0	100.2
Heptane	0.688	19,300	110,700	46.06	1.056	48.64	133	15.1	18.0	100.1
Octane	0.704	19,210	112,700	46.06	1.058	48.73	128	15.05	17.0	100.0
Nonane	0.710	19,135	113,200	46.06	1.059	48.78	...	15.0	....	.....
Decane	0.757	19,060	120,300	46.06	1.060	48.82	108	15.0	14.5	99.4
Aromatic Series.										
Benzol	0.884	17,330 17,302	127,700 127,400	46.9	1.013	47.51	172	13.2	26.0	100.1
Toluene	0.870	17,580 17,522	127,500 127,100	46.9	1.023	47.93	151	13.4	22.5	100.0
Xylene	0.866	17,810	128,600	46.85	1.029	48.26	148	13.6	22.0	100.6
Naphthene Series.										
Cyclohexane	0.780	18,880	122,800	46.04	1.045	48.11	...	14.7	21.5	100.0
Hexahydrotoluene	0.77	18,830	120,800	46.06	1.049	48.32	...	14.7	19.0	99.8
Hexahydroxylene	0.756	18,790	118,300	46.1	1.052	48.49	...	14.7	18.0	99.8
Olefine Series.										
Heptylene	0.70	19,170	111,700	46.8	1.049	49.1	...	14.7	23.0	102.5
Decylene	0.76	19,170	121,300(app.)	47.0 (app.)	.....	.....	...	14.7	....	.....
Alcohol Group										
Ethyl Alcohol	0.794	11,620 11,548	76,800 77,000	44.5	1.065	47.4	...	8.95	83.0	120.0
Methyl Alcohol	0.796	8,495 8,476	56,300 56,200	42.46	1.061	45.05	...	6.44	140.0	143.0
Miscellaneous										
Ether	0.719	14,670	88,000	46.8	1.068	49.98	158	11.14	27.5	107.0
Carbon Disulph	1.27	5,840	61,800	36.9	0.935	34.5	153	9.35	31.0	74.0
			per std. cu. ft.							
Acetylene	Gas	21,010	1,542	53.9	0.962	51.85	Gas	13.2	....	101.0
Carbon Monox	Gas	4,372	341	46.1	0.852	39.28	Gas	2.45	....	77.0
Hydrogen	Gas	52,830	296.4	39.8	0.852	33.9	Gas	34.3	...	66.0

Note.—Experimental observations of the calorific values of liquid fuels are made in a "bomb-calorimeter" in which the fuel before combustion is liquid and the products of combustion are cooled down to room temperature. The observed heat, therefore, includes the heat of condensation of the steam formed during combustion, the subtraction of this gives the "lower" values tabulated above. If the fuel before combustion had been in a state of vapor, the observed calorific values would be greater than those given, by the heat needed to vaporize the fuel in the bomb.

Note.—The above values colums E and F are calculated for an Air-Fuel mixture just giving complete combustion, at a temperature of 0° C. and absolute pressure of 29.92 in. of mercury.

Column I is calculated assuming specific heat of the fuel vapor is constant for all at 0.5.

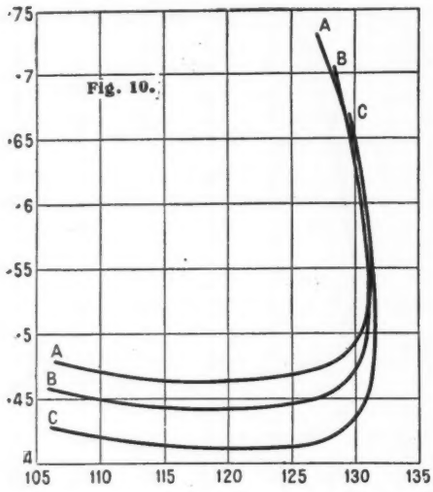


Fig. 10. Relation between I.M.E.P. and fuel consumption for different fuels at the same compression ratio which is sufficiently low to permit of each being used under the most economical conditions for that compression. Curve (A) is with aromatic free gasoline (S.G. .718). Curve (B) is with "A" gasoline (S.G. .782). Curve (C) is with benzol (S.G. .880). It will be seen that while the minimum consumptions vary widely, depending (at this low compression) solely on the heat values of the respective fuels, the maximum I.M.E.P., and therefore also the power output, is practically the same for each of these very different fuels

mate composition of each of the fuels on which power output was observed. From the composition of each fuel has been calculated (Column E) a figure of merit for power output which is exactly comparable with the values given for relative power output (Column J of Table VII) deduced for the pure substances in manner described. It will be seen that it is only for fuels (such as the alcohols) with unusually high latent heat that the observed power output (Columns H or F given in terms of indicated mean effective pressures) fall short of the calculated figures of merit (Column E). Column M gives the observed power output in terms of indicated mean pressure for each of the fuels under equal conditions of heating, but after full advantage has been taken of increasing the compression ratio up to the limit set by detonation or by pre-ignition for that particular fuel.

From the tables given above and from numerous other experiments of a similar nature to those recorded here, certain definite conclusions may be drawn.

With the exception of ethyl alcohol and methyl alcohol, which, on account both of their high latent heat and relatively large increase in specific volume, behave somewhat differently, and require special consideration, the following facts may be considered as having been established past all doubt. Mostly, they were arrived at first by purely theoretical reasoning, and have since been confirmed by actual tests carried out under conditions which ensure a very high degree of accuracy.

(1) That within very narrow limits the power output obtainable from any volatile hydrocarbon fuel or from any combination of such fuels is substantially the same when used with the same compression ratio provided that the compression ratio is sufficiently low to permit of each fuel being used to its full advantage for that compression.

(2) That so long as the ignition timing is adjusted to suit the normal rate of burning of the fuel the relative power output is the same at all speeds, i.e., there is no evidence to show that certain fuels giving more power relatively to another at low speeds, do not also give more power at high speed. This is shown in Fig. 9.

(3) That maximum power is always developed when the mixture strength is at or near that giving complete combustion. (See Fig. 10.)

(4) The power output obtainable from any fuel or combination of fuels when the heat supply is constant, or, more strictly, when it is proportional to the latent heat of evaporation of the fuel, is directly proportional to the energy content of the combustible mixture from which it would appear that the efficiency with which all fuels are burnt is the same. It will be shown later, when dealing with efficiency, that within narrow limits this was found to be the case.

In the case of alcohol and the other members of its group these conclusions require certain modification on account of their high latent heat.

In the case of the alcohol group the conclusions may be stated as follows:

(1) Owing to their low boiling-point it is unnecessary to provide much external heating; consequently the bulk of the fuel enters the cylinder in a liquid state, with the result that the temperature of the charge is lower, and the power output obtainable is considerably greater than from other fuels, although their total energy (see Table VII, Col. F) is actually somewhat lower.

(2) There is no evidence to show that their low rate of burning has any adverse influence on the power obtainable at very high speeds or very low compression ratios.

(3) Again, owing to the high latent heat and relatively large increase in specific volume, the power output obtainable increases as the mixture is enriched, and continues so to increase until the mixture strength is at least 20 per cent more than that required for complete combustion. (See Fig. 11.)

(4) Owing to the fact that in the case of this group, and this group only, an appreciable proportion of the fuel evaporates during the compression stroke, compression is more nearly isothermal, the temperature of the cycle, as a whole, is lower, and the efficiency is raised thereby. The power output is therefore increased somewhat, since a slightly greater proportion of the total internal energy available is converted into useful work.

Tests With Variable Compression

So far only the power output obtainable from different fuels when used with the same compression ratio has been considered. It is clear, however, that to obtain full advantage of the lower rate of burning of certain fuels each fuel should be run at the highest compression ratio it will stand without risk of detonation. For the purpose of these tests the variable compression engine proved invaluable, for the compression ratio could be varied to suit each sample within the space of a few seconds, and that without reducing either the speed or the load, or affecting any of the temperature conditions.

Although a very large number of tests were carried out extending over many months, the results obtained

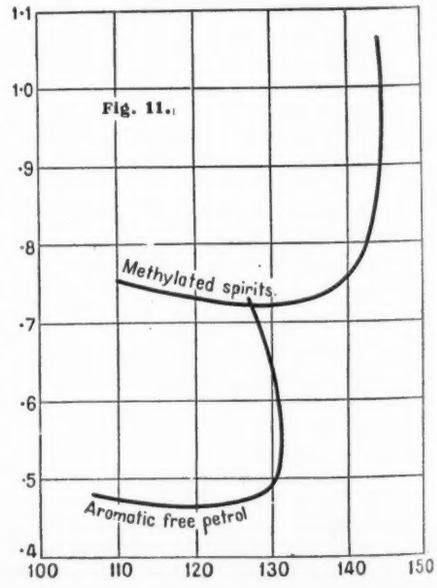


Fig. 11. Relation between I.M.E.P. and fuel consumption with gasoline and with methylated spirits (a mixture of alcohols). The results were observed under exactly equal conditions of compression ratio, heating and ignition timing. It is seen that while the minimum consumption of the methylated spirits is 55 per cent greater than for the gasoline, the maximum I.M.E.P., and therefore the power output, on methylated spirits, is 10 per cent greater also

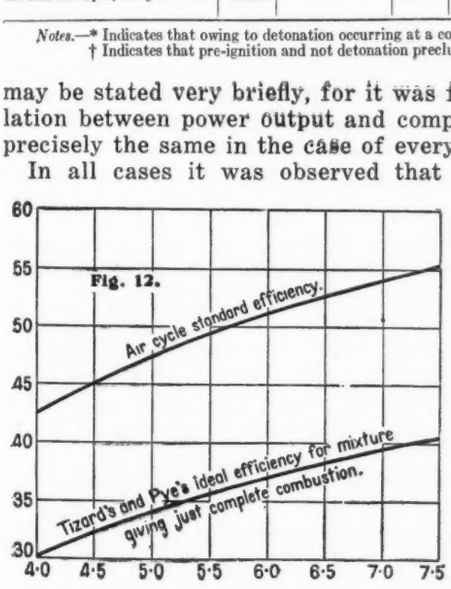
TABLE VIII

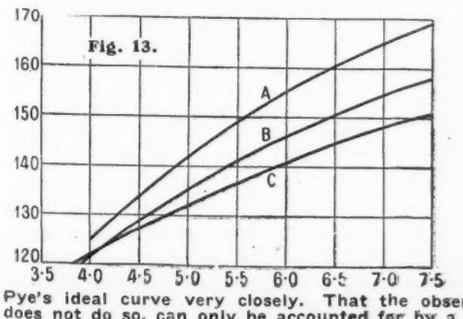
Fue	A.	B.	C	D.	E.	F.	G.	H.	I.	J.	K.	L.	M.
		Approximate Composition of Fuel			Calculated Figure of Merit for Power Output. Octane=100	With no Heat to Carburetor. Room Temperature 15° C. Compression Ratio 5:1		With 65 B.t.u. per Minute added. Room Temperature 15° C. Compression Ratio 5:1		With constant recorded Temperature of 15° C. Inlet Housing. Room Temperature 15° C. Comp. 5:1		With Highest Useful Compression Ratio for added Heat of 65 B.t.u. per Min.	
	S.G. at 15° C. 59° Fahr.	Paraffins, % by wt.	Aromatics, % by wt	Naphthenes, % by wt.		Indicated Mean Pressure lb. per sq. in.	Temperature °C. recorded in Inlet Valve Housing	Indicated Mean Pressure, lb. per sq. in.	Temperature deg. C. Inlet Housing	Indicated Mean Pressure, lb. per sq. in.	Added Heat required. B.t.u. per Min.	Ratio	Indicated Mean Pressure, lb. per sq. in.
Aromatic free gasoline	0.718	63	1.7	35.0	100.0	139.5*	10.0	131.3*	25.0	136.5*	24.7	4.85	130.0
"A" gasoline	0.782	26	39.0	35.0	99.9	139.6	11.0	131.2	26.0	137.2	17.3	6.0	140.1
"B" "	0.723	62	14.9	23.0	99.7	139.8	7.0	131.5	18.0	133.9	46.0	5.7	137.5
"C" "	0.727	61	8.5	30.5	99.7	139.5	8.5	131.0	22.0	135.0	31.2	5.25	133.9
"D" "	0.760	38	14.6	47.0	99.9	139.7	10.5	131.2	26.0	137.1	17.3	5.35	134.9
"E" "	0.719	68	11.3	20.0	99.7	139.5*	11.0	131.0*	25.5	136.3*	22.5	4.7	128.6
"F" "	0.704	80	4.3	15.2	100.3	139.9	8.0	131.8	20.3	135.2	37.0	5.05	132.7
"G" "	0.750	..	7.5	....	.....	139.6*	15.0	131.5*	33.0	139.5*	.....	4.55	127.4
"H" "	0.767	10	4.8	85.0	99.7	139.4	11.5	131.0	27.0	137.2	14.3	5.9	139.5
Heavy Aromatics	0.885	..	71.5	....	100.1	.....	....	131.1	43.0	.....	.....	6.5	142.5
Kerosene	0.813	..	....	....	99.5	.....	....	130.7*	46.0	.....	.....	4.2	123.0
Paraffin Series													
Hexane	0.685	77	2.7	20.0(app.)	100.3	140.1	Minus 2.5	132.3	15.0	132.3	65.9	5.1	133.1
Heptane	0.691	100 (to within 0.2%)	....	....	99.9	139.5*	8.5	131.2*	20.5	135.5*	34.7	<3.8	119.5 at 3.8:1
Aromatic Series													
Benzol, 98%	0.884	Negligible	98.0	Negligible	100.1	139.8	....	131.6	7.7	123.7	130.0	7.5†	150.0
Toluene, 99%	0.870	Negligible	99.0	Negligible	100.0	139.5	11.0	131.5	23.0	137.1	21.7	7.5†	149.6
Xylene, 91%	0.862	..	91.0	....	100.3	139.3	17.0	131.5	33.0	.....	.....	7.5†	149.2
Naphthene Series													
Cyclohexane, 93%	0.786	..	4.6	93.0	100.0	139.6	Minus 1.0	131.3	12.0	129.5	80.0	5.9	139.0
Hexahydrotoluene, 78%	0.780	..	10.0	78.0	99.7	139.5	5.5	131.0	18.0	132.8	49.0	5.85	138.4
Hexahydroxylene, 60%	0.744	..	....	60.0	99.7	139.0*	13.0	130.8*	28.5	138.0*	7.8	....	.....
Olefine Series		*Olefines*		*Paraffin and Naphthene*									
Cracked spirit	0.757	53	10.0	37.0	101.5	139.8	13.0	131.6	25.5	138.0	13.0	5.55	136.0
Alcohol Group		*Water*											
Ethyl Alcohol	0.798	1.5 to 2	....	....	120.8	145.2	9.5	137.8	16.5	139.3	52.0	>7.0	153.8 at 7.0:1
Methyl Alcohol (Purified Wood Naphtha)	0.829	Not fully analyzed	....	....	.....	151.7	Minus 1.0	144.8	6.5	135.5	152.0	5.2†	146.6
Methylated Spirits	0.821	7 (approx.)	....	....	132.6	151.3	6.5	144.5	14.0	143.2	76.0	6.5†	155.5
Miscellaneous				*Aromatic free petrol by vol.*									
Ether, 50%	0.727	..	....	50.0	103.2	144.3*	4.0	136.0*	16.0	136.5*	60.0	3.9	125.0
Carbon Disulph., 50%	0.994	..	....	50.0	83.2	135.0	Minus 4.0	124.5	8.0	.....	.....	5.15†	125.7

Notes.—* Indicates that owing to detonation occurring at a compression ratio 5:1 the value given is calculated from the observation made when running at the highest usable compression.
† Indicates that pre-ignition and not detonation precluded the use of a higher compression ratio, the sparking plug employed being K.L.G. type F 12.

may be stated very briefly, for it was found that the relation between power output and compression ratio was precisely the same in the case of every fuel tested.

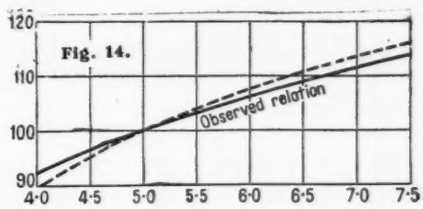
In all cases it was observed that fuels capable of standing high compressions give relatively to each other the same power output at lower compressions. At varying speeds up to the limit at present obtainable the relative power output of different fuels is the same.





Curve (A) — Relation between indicated mean effective pressure and compression ratio according to Tizard and Pye's ideal thermal efficiency for a mixture strength giving complete combustion, assuming a constant volumetric efficiency of 77 per cent of air at 0 deg. Cent. and 29.92 in. of mercury, but without making any allowance for heat loss to the cylinder head and walls. Curve (B) — The same relation according to the air cycle efficiency, assuming a relative efficiency throughout of 65 per cent and a volumetric efficiency of 77 per cent. Curve (C)— The relation of I.M.E.P. and compression ratio as actually observed.

NOTE—It will be shown later that the observed thermal efficiency follows Tizard and Pye's ideal curve very closely. That the observed mean pressure does not do so, can only be accounted for by a change in the volumetric efficiency.



The full line shows the observed increase or decrease of maximum I.M.E.P., and therefore of power output when compression is varied, as compared with that obtainable at a compression ratio of 5:1. The dotted line shows what would be this relation if it were proportional to the air cycle standard—that is, if relative thermal efficiency and volumetric efficiency were constant with varying compression. It appears that both are variable, but that with increasing compression the fall in volumetric efficiency more than balances the slight rise in relative thermal efficiency

At first sight one would naturally expect that when the compression is varied without involving any change, either thermal or mechanical, the mean effective pressure would be proportional at all times to the air-cycle efficiency corresponding to the compression ratio used. In Fig. 12 the upper curve shows the air-cycle efficiency over the range of compression from 4:1 up to 7.5:1. The lower curve shows Tizard and Pye's ideal efficiency for any fuel when the mixture strength is that corresponding to complete combustion. This latter curve takes into account the losses due to change in specific heat and to dissociation at high temperatures, but it does not take into account the direct heat loss to the cylinder walls, which is always more or less a variable quantity depending upon the form of the combustion

(*Continued on page 17*)

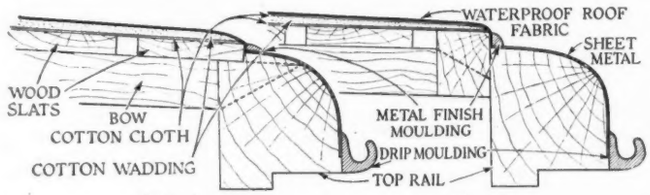
Combination Roof Construction for Enclosed Bodies

The so-called combination roof is not really a new development, except as regards certain specific characteristics. The savings made possible by the use of this construction are discussed here, together with the practical design of such a roof. Suggestive diagrams are presented.

By George J. Mercer

ALL solid roofs on enclosed automobile bodies, whether made of three-ply wood, agisote, or metal, are liable to generate a bell or drumming sound. This is due to the synchronizing of the sounds generated by the car in motion, or rather by such parts of these sounds as is carried to the body framing and to the resistance stresses that the large unbroken roof panel offers against the distortion of the body.

The ability of the solid roof panel to absorb shock with the minimum of complaint as registered in the drumming is proportionate to the increase in the arch and size of the top. If the roof has considerable camber, for instance, and the body is long enough to provide seven-passenger seating, a metal roof with a deadener of cotton wadding between the top sheet and the bows will give entire satisfaction. But there are many more five than seven-passenger bodies, while the coupes must also be taken into account. These latter are still shorter, while the tendency at present is to give them thin, flat roofs. Consequently, users of enclosed bodies to-day are frequently disappointed at the performance rendered.



Sectional views showing two methods of constructing roofs for closed cars.

Unfortunately, there is no established rules by which body builders can be certain that a specified roof camber and size of body, used with a specified solid roof material, will be soundproof. This is partly due to variations in the performance of different makes of chassis. A chassis that is flexible or that has a frame which undergoes excessive distortion, for instance, presents a very difficult problem to the body builder. Especially is this true when the spring action is snappy. When the foundation for the body has steadiness and ease of spring movement, however, the task of the body builder is less arduous. The so-called soft roof has been brought into use because of these conditions. It is new only in the sense that imitation leather is the covering used, while the foundation is generally wood slate 5/16 in. thick and 2 in. wide. These are set on top of the bows with a space of about 3/8 in. between them.

Leather roofs have been used by many high-grade custom body builders from the beginning of the art. The difference between the new practice and that of the past lying chiefly in the fact that formerly the foundation was cane work with a cotton cloth back for the lower layer, when the inside was skeleton finish or woven wire between layers of cotton cloth. When the inside is trimmed it has been customary to use wadding.

The high cost of leather, however, has rendered it adaptable only to very high class work, while the substitution of imitation leather increases the scope of the possible use of this construction. The cost of leather at sixty-five cents a square foot as against that of imitation leather at $1.80 a square yard, means a saving of about $25 on the material for a five-passenger sedan. The difference in construction cost is not only in the prices of the materials, but also in the fact that there is no waste in cutting imitation leather.

A saving of $25 can be made by the use of imitation leather as compared with an all-metal roof for a five-passenger sedan; compared with agisote or a built-up wood roof, the saving would be about half as much. These cost comparisons are based on the customary method of applying imitation leather; that is, by continuing the drip moulding around the back and fastening the imitation leather to it. The comparisons would not apply in the case of the accompanying diagram, since a combination of metal and fabric is presented there. The saving possible by the substitution of imitation leather in this case would be about $5.

The illustrations show sections of the roof of a sedan. Two methods of improving the appearance of the soft roof are indicated. By this means the combination roof is given the high-class appearance of the metal roof without the disadvantage of noise which accompanies the latter. At the same time a leak-proof roof is insured.

The less pleasing appearance of the soft roof arises from the fact that the fabric is brought over the rounded corner of the roof rail and fastened at the drip moulding. It is, therefore, made to contrast with the lustre paint finish of the panels and, as the sun, rain and dust quickly take their toll from the fabric, the contrast, which at the first was disproportionate, is constantly emphasized more strongly.

The illustration shows one way of getting the advantage of the soft roof without the shabby side line and without taking any chance of the rain leaking through. Ordinarily when the leather or fabric is stopped on the flat of the roof, a half oval moulding is used to cover the joint. Such a moulding, however, is above the level and will, therefore, prevent a natural drainage. Thus the water held back will in time seep through.

The design shown in Fig. 1 is best for economy and ease in production. The bows are assembled in the regulation way, the slat rests in a shallow roofrail rabbet and projects above sufficiently to form the necessary step for making the water shed. The illustration is self-explanatory to a large extent. The top or outer fabric is drawn over and tacked to the perpendicular edge of the slat, meeting the sheet metal at the corner. The metal finish moulding is set in lead or thick primer, is jammed tight and is fastened with screws or barbed nails to the hardwood of the roofrail. Lead silled moulding with set-in nails will work well, however, in certain cases. It can be readily seen that no obstructions are in the way of the natural flow of the water from the top to the drip moulding.

Fig. 2 simply shows a way to carry the dividing line further back on the roof; such construction is very much more expensive in the wood shop.

New Self-Lubricating Bearing Material

DEVELOPMENT of a new bearing material which is a mixture of bronze and graphite, having self-lubricating qualities has recently been announced by the General Electric Co., following successful tests under service conditions. The commercial stage was attained by this material after research extending over a period of several years.

The new material, known as Genelite, contains graphite amounting to 40 per cent by volume of the whole mass. Tests have shown a high degree of porosity, the metal being able to absorb as much as 2½ per cent by weight of oil. Fig. 1 is a piece of apparatus set up to show this feature of the material. Oil from the upper beaker is siphoned into the lower through the rod of Genelite and the woolen wick by capillary attraction in both. This characteristic is made use of in high speed applications where oil is applied to the outside of the bushing and carried through to the bearing surface by capillary attraction. Another characteristic is said to be that the bearing never seizes or freezes, or, the metals of the shaft and the bearing never flow or weld together. If a baring sticks, owing to too close a fit, all that is necessary is to reassemble it with the proper fit, no damage being done to the shaft or bearing.

Among the self-lubricating uses for the new bearing are brake rod bushings, clutch centering bushings, throttle control, fan and pump shaft bushings, where such material saves much trouble and expense of overhauling and repair. Genelite has proved useful also for engine main bearings, crank pin bearings and piston pin bushings which are supposed to be well lubricated at all times, but where water is likely to be excessive due to the oil losing its lubricating value from dilution by unconsumed fuel, or insufficient oil.

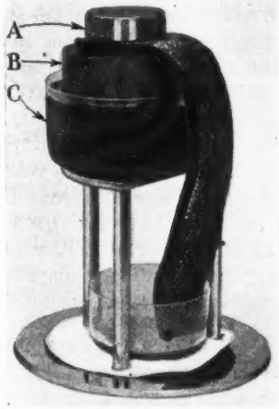


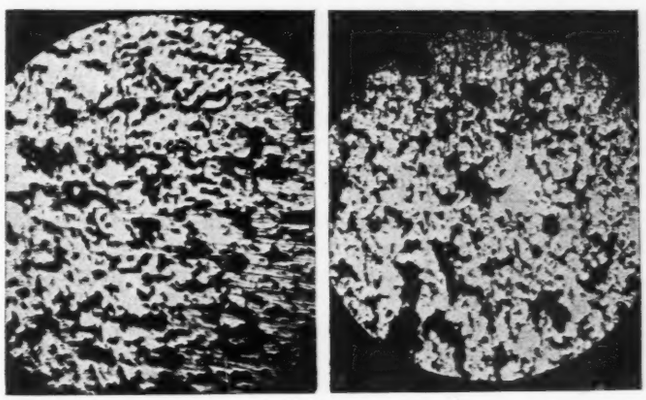
Fig. 1—Test to demonstrate porosity of genelite.

Genelite is made from the oxides of tin, lead and copper, composing a high-grade bronze, plus graphite, all the materials being in a finely divided state. Graphite is added in sufficient excess quantity to reduce the oxides to the metals and leave the required graphite content in the finished material. The oxides are partially reduced by heating the mixture.

The mixture, still in powdered form, is then pressed as nearly as possible to the required shape in massive metal molds. In this pressed form it will not stand much rough handling, so it is given a final bake, which sinters the metals together into a homogeneous bronze, holding the graphite uniformly distributed throughout its mass.

Figs. 2 and 3 are microphotographs of cross sections of the same piece taken on two planes intersecting at 90 deg., and show the even distribution of the graphite particles. The white spots are the bronze and the black ones the graphite. The baking serves to clamp the graphite particles securely within the mass of bronze, so they cannot be washed out or detached save by dissolving away the surrounding metal with acids.

The material has the general appearance and body of bronze, but the characteristics are different. It does not machine readily by the ordinary methods, but can easily be ground, which has been found to be the best


Figs. 2 and 3—Cross and flat sections of genelite, former showing uniform distribution of graphite. Magnified 100 times.

method of handling it in quantity. Neither has it the physical characteristics of bronze, having very low tensile strength, but withstanding high compressive strains.

When considering the relative performance of bearings, great care should be taken that all the factors entering should be given due consideration. A self-lubricating bearing should never be compared with a lubricated one, for no bearing will give as good results unlubricated as a similar bearing properly lubricated. But it is sometimes necessary, due to inaccessibility of parts or neglect on the part of the user, to install bearings that are self-lubricated.

A GLOSSARY of Aeronautical Terms prepared by the Technical Terms Committee of the Royal Aeronautical Society and approved by the Engineering Standards Association has been issued by direction of the Air Council, and copies can be had from H. M. Stationary Office, London. The publication embodies a schedule of aerodynamical symbols approved by the Advisory Committee for Aeronautics. Translated and adapted to the French by Flight Lieutenant Leonard F. Plugge, the Glossary forms Air Publication No. 822. This is probably the most complete and up-to-date French-English glossary of aeronautical terms published.

Investigation Into Properties of Lubricating Oils

Report of tests made by British committee covers measurement of co-efficient of friction at various temperatures and with oils of various viscosities. Comparisons of vegetable, animal and mineral oils with and without addition of refined or deflocculated graphite are included.

A COMMITTEE on Lubricants and Lubrication appointed in March, 1917, by the British Advisory Council of the Department of Scientific and Industrial Research, has issued a lengthy report on the results of its inquiries. It was found that the work assigned to the committee could not be accomplished solely by inquiry, and permission was sought and granted to make certain experiments.

The worm gear testing machine designed by F. W. Lanchester, and presented to the National Physical Laboratory by the Daimler Motor Co. was used to determine the lubricating properties of various mineral, animal and vegetable oils. This machine can measure the efficiency with which power is transmitted through it with an accuracy of 0.2 per cent. The method employed is the direct measurement of the ratio of the torque in the worm wheel shaft to the torque in the worm shaft. The loss of power is thus directly measured, and is not deduced as the difference of two large observed quantities. Means are provided for testing an oil on the machine over a range of temperature. It was found that for all the mineral oils tested a certain critical temperature existed beyond which the running of the gear became unsteady, and the rate of fall of efficiency with rise of temperature showed a marked increase. Animal and vegetable oils did not exhibit a critical temperature at least up to 75 deg. C. (167 deg. Fahr.) Castor oil gave the highest efficiency under the particular load employed during the tests, namely, 95.6 per cent. The efficiency of the gear with castor oil as the lubricant remained constant at this value at all temperatures from 30 deg. C. (86 deg. Fahr.) upward. Rape and trotter oil came next in order of merit to castor oil, the efficiency being practically constant at 95 per cent for both these oils. Sperm oil at normal temperatures gave an efficiency as high as any of the other oils tested, but as the temperature was raised the efficiency with this oil decreased gradually. The critical temperature shown by all the mineral oils tested was raised by the addition of rape oil, but the addition resulted in very little improvement in the efficiency figure. It was noted that the beneficial effect on the critical temperature could be produced by the addition of 2½ per cent of rape oil, and that any farther increase up to 20 per cent was without effect.

The addition of colloidal graphite to the oils under test was examined for effect. In the case of animal and vegetable oils, colloidal graphite—"Oildag," to give it its trade name—had a beneficial effect, but the improvement, according to the report, "was so small as to be hardly appreciable." With mineral oils, beneficial results were found in four out of five samples. The fifth sample showed no benefit from the addition of colloidal graphite. The addition of natural flaked graphite of great purity was also examined. Animal oils showed an appreciable improvement in the efficiency, no change was detected in vegetable oils, while for mineral oils two samples were improved and two left unaffected. In no case did the addition result in a reduction of efficiency, but there was evidence that the wear on the gear was increased by the presence of the flaked graphite.

The Lanchester gear tests, combined with the results of viscosity tests for the oils used, failed to provide any evidence for the assumption that the frictional resistance of the gear is dependent solely on the viscosity of the oil. Thus the viscosity of castor oil at 40 deg. C. (104 deg. Fahr.) is about six times as great as that of trotter oil, yet the frictional resistance of the gear was roughly the same in both cases.

Viscosity and Pressure

As no tests appeared to have been carried out to determine how the viscosity of oil varied as the pressure was increased, special apparatus was designed to permit the viscosity to be measured at all pressures ranging from atmospheric up to 10 tons per square inch. It was found that at high pressures all the oils showed a very large increase in the co-efficient of viscosity. Thus at a pressure of 6.5 tons per square inch one mineral oil showed a co-efficient twenty-five times as great as that found for it under atmospheric pressure. This increase was the maximum noted. At the same pressure the increase in the co-efficient for castor and trotter oils was only 4 to 5. In general, mineral oils revealed a greater susceptibility to pressure than animal or vegetable oils. The viscosity determined was the kinematic viscosity, that is, the ratio of viscosity to density. Apparatus was designed to determine how the density of the oils varied under pressure, so that the true relation between pressure and ordinary viscosity might be deduced. It was found that the correction for varying density was not large, and that the conclusions previously reached held good.

The Deeley Oil-Testing Apparatus

A machine designed by R. M. Deeley was constructed to enable the static and low-speed kinetic friction between flat metallic surfaces to be measured when the surfaces were dry or partially or fully lubricated with various lubricants and under various loads. Preliminary tests only have so far been carried out with this machine. It has been found that the static co-efficient of friction differs when the two surfaces are of different metals, although the lubricant is the same and also when the surfaces are the same and the lubricant is different. The results are held to indicate that "oiliness"

is a surface effect produced by the lubricant upon the metallic surface with which it is in contact. A consideration of the latest results obtained with the machine suggests, the report says, that there is a possibility of obtaining satisfactory lubrication between plain parallel surfaces without the use of tilting devices as in the Michell blocks.

Three oils were tested for the Air Ministry in the Lanchester worm gear. The first, "Mobiloil A," showed an efficiency of 95.5 per cent practically constant at temperatures up to 50 deg. C. (122 deg. Fahr.). Thereafter the efficiency fell off rapidly as the temperature was raised. The second, "Mobiloil B B," gave a constant efficiency of 94.8 per cent at temperatures below 60 deg. C. (140 deg. Fahr.), while at higher temperatures the efficiency fell off at the same rate as for the first oil. The third oil was castor oil, according to the report. In this case the efficiency fell off gradually as the temperature rose, being 96.5 per cent at 31 deg. C. (88 deg. Fahr.), 96 per cent at 35 deg. and 95.5 per cent at 100 deg. C. (212 deg. Fahr.). In a previous section of the report, as we have recorded, it is stated that castor oil showed a constant efficiency of 95.6 per cent at all temperatures from 30 deg. upward. The discordance of these two sets of results may perhaps be explained on the supposition that a misprint has occurred in the report, "castor oil" in the case of the third oil tested for the Air Ministry having been printed instead of the somewhat similar name of a well-known proprietary brand of lubricating oil.

Cavitation in Oil Films

At a Royal Institution lecture by S. Skinner on experiments in the liquid state, experiments were performed showing the formation of cavities in oil films when the oil was introduced between a pair of lenses or between a lens and a plane and when the lenses were rolled or rocked above a certain critical speed. These results were brought to the committee's notice, and were farther investigated at the National Physical Laboratory by means of a half-bearing of glass carrying a load and supported on a steel shaft 1¾ in. in diameter. In this way it was possible to study the flow of oil over a simple journal bearing both during the first revolution of the shaft and subsequently. The results obtained are believed to afford "a reliable indication of the general action of a lubricant in a bearing." The film was found to be ruptured on both sides of the line of nearest approach, and in general the facts observed confirm Mr. Skinner's observations.

"Oildag" in Aero-Engines

The results of some tests carried out by the Air Ministry on the degree of benefit to be derived from adding "oildag" to the lubricating oil used in aero-engines were communicated to the committee, and are published in its report. In one case, evidence was obtained that the use of "oildag" may lead to reduced oil and fuel consumption per brake horsepower hour. In two trials, however, it was made clear that greater carbonization in the cylinders was to be expected when "oildag" was used. In one instance, the consumption obtained with "oildag" was above rather than below the normal consumption without "oildag." The results generally, it is added, were not conclusive, and it was considered that farther trials were needed in order to make it possible to say with certainty whether the differences in oil and fuel consumption with and without "oildag" were due to engine design or to the type of lubricant.

Some tests were carried out at the National Physical Laboratory with the object of determining the frictional coefficient of a shaft bearing using oil with and without "oildag." The apparatus used consisted of two self-oiling plummer blocks, in which a shaft was rotated by an electric motor, the plummer blocks being attached to a frame work which could be loaded and the coefficient of friction determined by torque measurement. Two kinds of oil were tested with and without "oildag." With the first oil the addition of "oildag" resulted in a reduction of about 11 per cent in the coefficient of friction at 60 deg. C. (140 deg. Fahr.). With the second—a thinner—oil, the coefficient "was actually higher with the addition of 'oildag' than without it." This test, the report adds, was carefully repeated, and confirmed at a subsequent date.

Copies of the Report of the Lubricants and Lubrication Inquiry committee may be had from H. M. Stationary Office, Kingsway, W. C., 2, London.

Influence of Various Fuels on Engine Performance

(*Continued from page* 13)

chamber, the speed and many other variables.

In Fig. 13 curve (A) shows the variation in mean pressure with compression which might be expected if the efficiency relative to the air cycle remained constant at all compressions. Curve (B) shows the mean pressure which would be obtained if the efficiency bore a constant relation to Tizard and Pye's ideal efficiency.

Curve (C) shows the relation between the mean pressure and compression ratio actually observed.

This relation, which could be obtained with a high degree of accuracy, did not vary measurably as between numerous tests on any one fuel or on several different fuels.

That the mean pressure developed does not follow either the air-cycle standard or Tizard and Pye's calculated values is explained by the fact that the volumetric efficiency falls as the compression ratio is increased. Why it should fall still remains a mystery. Many theories have been advanced, some of which, no doubt, go some way toward explaining the change in volumetric efficiency, but none can, in the writer's opinion, explain the existence of so large a variation.

It will be shown later, when dealing with the question of efficiency, that the actual observed efficiency rose in relation to the air cycle, while the mean pressure fell in relation to it—a somewhat surprising phenomenon, in view of the fact that, so far as any change in the efficiency of the combustion chamber was concerned, it must have decreased with increase of compression, though every endeavor was made to reduce this variable to the lowest possible limit.

Fig. 14 shows in full line the observed percentage increase or decrease in mean effective pressure, taking as basis a compression ratio of 5:1. The dotted line shows what would be this relation if the i.m.e.p. were proportional to the air-cycle standard. The full-line curve may be taken as applicable to all fuels or combinations of fuels without distinction or qualification. To apply it, it is necessary only to refer to Table VIII, Column L, which gives the highest safe compression ratio at which the fuel may be used, and to add or subtract the necessary percentage observed. Table VIII, Column M, shows the mean effective pressure actually observed with each fuel at 1500 r.p.m. when run at the highest compression ratio consistent with freedom from detonation.

Hand Work Important Factor of Storage Battery Manufacture

Engineers are interested in the production methods used in plants from which they order equipment. This article describes the chief features of storage battery manufacture in a typical plant. Economy of movement is an important feature of the process discussed here. Over 100 operations are performed every hour throughout the production system.

By J. Edward Schipper

THE manufacture of storage batteries in a plant having a capacity of 1000 per day offers an excellent opportunity for motion study. The nature of the work is such that machinery is used to only a limited amount, the majority of the work being bench work or hand work of various kinds.

The Ray Battery Co., which has recently moved to Ypsilanti, has increased its production from 300 batteries a day to 1000 a day, and has found that in the production of this quantity it is necessary to make a very close study of economy of movement in the men employed in order to bring the unit cost per battery down to the proper basis. The plant operates on a 9-hr. day, which means that throughout the entire production system a capacity of somewhat over 100 completed operations per hour must be reached.

Casting Lead Grids

The primary operation is the casting of the lead grids. This, as well as all of the operations throughout the plant in which it is practicable, is a piecework operation. The plant equipment consists of nine molds of the type shown in Fig. 1. A good operator can mold 200 of these lead grids per hour, and, as will be noticed from the illustration, the movements of the operator's hands are very limited, indeed, in order to fulfill his work. The molten lead is adjacent to his right hand, and with the left hand he operates the mold, which is a special design worked out by the Ray battery production men. A movement of the right hand scoops up sufficient lead in the measuring ladle to just fill the mold. This is poured and practically instantaneously the lead is cooled sufficiently to be hard. The mold is then opened and the finished grids taken out and placed upon the pile at the operator's left hand.

The interesting feature of this operation is the small amount of movement necessary to do the work. Practically no body movement at all is required, simply action by the left and right hands and arms. Following the operation of casting the grid, it is necessary to clean it up and trim it. This is done on a Michigan press, which shears off the excess metal, as shown in Fig. 2. This is an ordinary type of punch press, and the work of trimming these grids is also a piecework operation.

After the punch press operation, the grids are ready to receive the paste, which issues from a bin through an opening in the wall of the secret mixing chamber. As a great deal of the efficiency of the Ray battery is wrapped up in the use of the particular paste formula employed, every effort has been made to keep the knowledge of the ingredients of this paste confined to one or two members of the Ray battery staff. An unusual feature of the battery is that the same paste exactly is used for both negative and positive plates.

The operation of pasting up the grid is similar to any other grid pasting operation with other batteries. It is done by means of a putty knife, and skillful operators will average 175 grids per hour. There is no distinction between the negative and positive plates on this filling operation. The grids are then dried, an operation which takes about 12 hr. at 120 deg. Fahr. The grids are inserted in drying racks, as shown in Fig. 4, preparatory to being placed in the oven, where the drying temperature is maintained. This operation follows directly after the hand pasting described.

After the plates have been withdrawn from the drying oven they are put through a chemical forming process, which differs materially from usual manufacture and by nature of which the time required for the manufacture of the battery is materially shortened. The usual time for battery manufacture is 14 days. By the chemical forming process employed by the Ray Battery Co. this time has been shortened to 8 days, which, of course, considerably decreases the amount of work in process at any given period and consequently makes the operation of battery manufacture that much more economical. The ability to use the chemical process is claimed by the Ray company to be due to the use of the Lavere paste formula employed in the plates.

Trimming Lugs

After this chemical forming step is completed, the lugs are trimmed off the plates and they are then mounted in assembly racks. The plates are assembled in groups, as shown in Fig. 6. This is done in special racks which permit of fitting and burning in the same rack. Fig. 7 shows the operation of burning straps onto the plates. After the soldering is completed, the plates are matched in negative and positive groups and the separators inserted. This is also a hand operation, as shown in Fig. 8. The plate group is then ready for insertion in the jar, where it gets its bath of electrolyte and is put on the first cycle of charge.

These jars or cells are carried by trucks to the charging stands, where the batteries are placed on charge, being put through the several cycles. The charging racks call for 60 batteries in a row, and the trucks are so matched up with the platforms upon which the cells

1—Moulding lead grids. A piece-work operation which averages 200 per hr. from each mould. 2—Trimming of grids in ordinary punch press. A piece-work operation. 3—The paste comes out of the mixing room in periodical batches through the trap door shown. From here a distributor carries it to the pasters. 4—Filling grids with paste. A hand operation on a piece-work basis which averages 175 per hr. per man. 5—Inserting plates in drying racks preparatory to furnace drying at a temperature of 110 deg. This operation follows directly upon the hand pasting. 6—Assembly of straps and plates done in special racks which permit of fitting and burning in the same rack. 7—Burning straps onto plates. 8—Male and female plate assemblies are joined and separators inserted as shown here. The group is then ready for insertion in the jar, where it gets its bath of electrolyte and is put on the first cycle of charge

9—Method of handling groups of cells in the various processes of charge. 10—After cells have gone through their various charging cycles they are dropped into the boxes and trucked to the compound department. 11—Burning on connectors. From here the battery goes to final inspection and paint dress-up, thence to the shipping-room. 12—Compound is poured, after which the battery progresses down the bench to the connector burning process

rest that they can readily remove a group of cells and place them in the desired position with a minimum of effort. This truck operation is shown in Fig. 9. The method of raising the platform of the truck to carry the cells is shown.

The cells are lifted from the charging stands directly into the boxes which are on a platform on the same level as the cells, so that the operator has no carrying of any consequence to do. He simply reaches over to the charging stand and lifts up the jar from one side and places it on the other side in the boxes. After the cells have been dropped into the boxes, they are taken by the trucks to the sealing department, where tar is poured around the jars, thus sealing the batteries in the battery boxes. The connectors are then burned on and the batteries are finished, painted, inspected and the plugs put in.

TO eliminate entirely the question of "feel" in micrometering, Rudge-Whitworth have patented a combination of an ordinary micrometer with a spring balance. The latter has a dial gage, similar to those used for weighing letters, and the micrometer is mounted in the place of the usual scale pan. The micrometer having been set, the article to be measured is passed downward between the measuring faces and the friction of its passage is indicated on the dial of the spring balance. A difference in size of only one hundred-thousandth of an inch is detectable by this method. For the measurement of gages the "Millimike," as the device is called, should be particularly useful. For setting the micrometer to known dimensions, hardened steel balls up to 1¼-inch diameter are supplied, which are certified accurate to size within the limits of possible measurement.

Factors of Territorial Analysis

Marketing has not undergone the close analysis to which production has been subjected. Its problems are less tangible and many human and psychological factors are involved. Analysis must determine the unknown factors and their relation to each other. This article discusses one phase of the problem which is important to practically every sales department.

By Norman G. Shidle

THE shotgun method of selling cars has had its day. Scattering fire of sales effort cannot stand up under the close scrutiny of expenses which must now be directed by the management on every part of the business. The problem of correlating production with sales has become a live one for the first time in years.

Conditions and ideas will differ in various plants. One automobile manufacturer who has been specially successful in selling during this period of business depression takes the attitude that the production department is supreme, and that it is the function of the sales department to sell the cars necessary to keep the production facilities operating efficiently at all times.

In other plants the sales department is the dominating factor. The sales manager determines to the best of his ability how many cars he can dispose of during a coming period, and the production department is expected to adjust itself to the conditions imposed by the sales department. Just at present it is not difficult for the production department in any plant to accomplish this, but conditions were very different a year ago. In any case, the relationship between the production and selling departments and the proper correlation of the activities of the two constitutes an important problem; a problem which is found to be solved differently in different plants.

The necessity has arisen for some sort of accurate territorial analysis, some reasonable standards upon which to judge performance and some fairly accurate method of predicting future performance.

The purpose of such an analysis may be for the purpose of determining the capacity of a plant about to be built, or for determining where the capacity of an existing plant may be sold. The latter is the commonest purpose, but in either case the methods of analysis may proceed along similar lines.

To establish a quota for any given territory is easy; to establish a fair and accurate one is very difficult. An inaccurate quota is worse, of course, than no quota at all. Inaccurate standards of performance simply warp the entire view of the performance itself.

In discussing quota and territorial analysis, the term quota needs to be defined. In some cases quota is considered as being the share of plant capacity which shall go to a given unit. This relation is relative, however, and to be determined accurately must rest upon a more fundamental analysis. It is the result of such an analysis that constitutes the true quota, as the term is used in this article. Quota is the number of cars that a given territory is capable of absorbing. In other words, a territorial analysis aims at determining the maximum market for cars in a given territory. Once this has been done, it is simple to adjust the relative values in apportioning factory output or in setting actual performance quotas for dealers in such a way that they are suitable for practical use. The analysis on an absolute basis is the scientific foundation, however, for the other type and constitutes the basis of the present discussion.

BEFORE a territory can be analyzed a proper territory must be defined. A sales territory cannot be intelligently designated by simply using a map. Spheres of city influence, newspaper circulation, arterial roads, local buying habits and other factors enter into determining "when a territory is not a territory" and vice versa. This is a preliminary to the factors discussed in this article.

A few companies have recognized the necessity for effort of this kind and have done considerable work along this line. These efforts have already paid for themselves and have greatly aided in selling through the present difficult period. It is interesting to note that at least two companies which have done the most work in regard to territorial analysis and the establishment of accurate quotas have weathered the recent industrial storm better than most others and, with increased efforts, have made their 1921 sales equal or surpass those of 1920 for corresponding months.

Two Main Phases

There are two phases of sales analysis from the standpoint of the manufacturer. The factors to be considered must first be determined. Then their relative importance in relation to one another must be established in order to properly evaluate any given territory. To accomplish both of these things to the highest degree of mathematical accuracy is manifestly impossible. To accomplish them to a greater extent than has heretofore been done is not only possible, but necessary. The more careful the analysis and the more intelligent the study, the more accurate and valuable will be final results.

This article proposes to discuss these two phases in a purely qualitative way, with the idea of indicating the various factors involved and the things which affect their relative importance in a study.

The first factor of territorial analysis for passenger cars is likely to be population. Population may be said to indicate the total number of persons who might ride

in cars. It does not indicate directly, of course, the actual market for cars. Indirectly, it has a definite bearing, however, since, other things being equal, the place with the largest population offers the largest market. Since other things are not always equal, however, the market in two territories will not necessarily be in direct proportion to the population.

It may be said, then, that population is a factor in every sales analysis, but that it must be correlated with other special factors in any given case in order to be accorded its proper significance.

Closely allied with the actual population factor is the number of persons per car. Under present conditions the importance given to this factor should be carefully considered. In many states it is impossible to get this figure with any degree of accuracy, because car and truck registrations are not segregated. Moreover, the conditions of territories in various parts of the country differ so greatly as to render this factor of varying importance in different places.

The total car registration for the territory constitutes another factor. Here, again, difficulty is experienced when cars and trucks are not segregated. In addition to the total registration, however, other more detailed factors must be considered. The number of Sennett cars in the territory should comprise a factor in an analysis made by the Sennett factory. One factory, for instance, has already in operation a system by means of which they can determine by reference to a factory file the territory and ownership of every one of its cars.

Then the number of competitive cars in the territory should be taken into account. The data can be obtained by some expenditure of money for lists. This factor is equally as important as that of the number of Sennett cars. It indicates not only the sales performance of the Sennett dealer and the competitive dealers, but also the possible market in an indirect way.

The model as well as the number of Sennett and competitive cars in a territory should be known. With this data the approximate number of replacements can be calculated each year. This will also have some bearing upon the used-car market and the relation which it bears to sales resistance. In this connection, the replacement possibilities in cars of a class lower than the Sennett might be considered. For this purpose the same data should be available on cars of this lower class as for Sennett and competitive cars.

Financial Factors

The factors having to do with actual buying power are of supreme importance. To determine them accurately and to correlate them properly constitutes probably the most difficult part of the sales analysis task.

Income tax returns offer one obvious source of data. Certain information can undoubtedly be obtained from this source. Men in certain income classes may be considered prospects for Sennett cars. This factor should be considered as exclusive, however, rather than inclusive. Suppose, for instance, that persons with an income between $2500 and $5000 are considered as Sennett prospects. All those showing such incomes on the income tax returns can be properly considered as prospects. But that number is by no means the limit of the number of prospects in that territory.

There is a farmer up in New York State who earns about $500 a year. He is employed by the owner of the farm and has no outside resources or income. He has a wife and three children. This man will never appear in the income tax returns. Yet he has owned a car for over three years. And this case is not exceptional. The income tax returns do indicate certain things about sales markets, but they must be considered in relation to other factors or they give false impressions. The vast number of persons who must own a car for business purposes, regardless of their status as regards income taxes, give another excellent example of the fault of laying too much importance upon this single factor by itself.

Property values constitute another possible factor. These, too, must be carefully considered in their relation to other factors. Property values are, in a sense, a measure of the community wealth, yet they may be a very false measure. It is the distribution of property that counts in automobile sales, not the total value. There is a small manufacturing town in Pennsylvania, for instance, where nearly the whole town is owned by the head of the one large factory. There are few high-salaried men in the town. The market for cars is comparatively small, yet the property values would show a considerable total.

It must be remembered that high property values usually reflect high rents, which in turn act as an increased sales resistant. The distribution of the property, the number of persons who own their own homes, as against the number who pay rent, these are the factors of importance, rather than mere property value.

Financial ratings are also a factor in selling cars, especially for business purposes. They are not as large a factor, however, as in selling trucks. Factory wages, as well as income tax returns, might form a factor in certain instances.

Economic and Local Factors

There are certain local economic factors which will influence the market in any given territory. The matter of garage facilities is one. Here, again, the limitations of the income tax factor are illustrated. In a territory where most car owners have to pay from $20 to $35 a month for housing their car, the sales resistance will be very much greater than one in which most users can house their vehicle in a private garage for a very small sum.

Local topographical conditions may influence the sale of a particular car in certain localities, while current business and economic conditions are certain to have an effect. Whether the territory is urban, suburban or rural is a factor in making or reducing sales resistance and, consequently, is a factor in properly evaluating a given territory.

These factors are intangible, and, unlike most of the others mentioned, can be reduced to a place in a formula only with considerable difficulty. Since they are present factors, however, they should be taken into consideration along with the rest of the problem.

The Human Side

The human and psychological factors which enter into the value of a given territory are also of immense importance. So little is known about this phase of the question at present, however, that it can be discussed only briefly in a short article. The community likes and dislikes, the intangible whims of the public in a given area, the psychological factors which enter into merchandising, all these things must have a part in the ultimate determination of accurate territorial valuation.

Why do people in New York prefer white eggs, while Boston housewives are willing to pay a higher price for brown eggs? Such a question as this cannot be answered on the basis of economics. It has to do with the psychological phase of merchandising. Discussing this point in his book, "The New Business," Harry Tipper says:

"That the older methods of marketing and the older methods of doing business are inadequate to the present-day situation is obvious, both from the history of commerce and a study of present friction and unrest.

"What changes will be effected it is difficult to say, and much investigation and analysis are necessary before any direct statement as to changes would be of value. Certainly not until analysis has determined a good deal more effectually the unknown factors which enter into marketing would it be other than absurd to talk of much change.

"As the analysis, however, develops some of these factors, it is probable that the new spirit of marketing will become a factor in business in the same way that the new methods of production have dominated the manufacturing."

The factors mentioned comprise the chief things to be considered when attempting to thoroughly analyze a territory from the manufacturer's viewpoint. For greater clearness they may be listed in tabular form:

1. Population.
2. Number of persons per car.
3. Total registrations.
4. Number of Sennett cars in territory.
5. Number of competitive cars in territory.
6. Number of next lower price class in territory; in case of some cars, number of people who own more expensive cars in territory.
7. Model (year) of Sennett cars in territory.
8. Model (year) of competitive cars in territory.
9. Model (year) of next lower price class in territory.
10. Income tax returns.
11. Property values.
12. Distribution of property.
13. Financial ratings.
14. Current factory wages.
15. Local economic conditions.
16. Local business conditions.
17. Local topographical conditions.
18. Human and psychological factors.
19. Factory production capacity.

The importance of each of these factors will be different in the case of each different type of car. Some of the factors will be practically negligible in connection with certain makes and important in connection with certain others.

To determine the relative importance of each factor, to determine the relation of each factor to each other factor; to correlate the data obtained concerning each of the factors—this is the second phase of territorial analysis. It is the most difficult phase. Perhaps sufficient data are not available on the basis of present records to successfully complete the second part of the task. Perhaps more study and analysis of the various factors will be necessary before definite progress can be made in this direction.

It is altogether likely that this is the case. One automobile company, which has gone into this matter more extensively than most others, has devised a formula for territory valuation which it is using at the present time. This formula is different than the one used six months ago, and is likely to be changed again within the next six months.

The factors outlined here merely present a basis upon which territorial analysis for car sales may proceed. The problem of the individual sales manager is to build his own analysis on the basis of these factors and to determine for his particular car the relationship between the various units involved. Some progress can be made immediately in most cases. The field has been little studied, and experimental data is comparatively meager.

It is perfectly possible that experience will show that it is not feasible to establish a standard quota formula which will be good forever, even for a particular car. The relative importance of the various factors may be found to vary from year to year and from territory to territory. It may be necessary to constantly adjust the territory valuation. But if this is found to be necessary, the sales manager of the future will be able to make that adjustment upon the basis of accurate data and intelligent analysis. The factor of error will be reduced to a minimum.

It is not likely that the description of the working out of the second part of this analysis task can be written in the near future. But experiments can be made which will furnish quantitative data upon which to base further progress. This is the present problem of the merchandising departments.

Output of Single and Multi-Cylinder Engines

A TEST was recently conducted at McCook Field on a single Liberty cylinder mounted on a universal base to determine the power, friction losses, temperature and heat transfer characteristics. This performance was compared with the average of eight standard 12 cylinder Liberty engines in order to obtain a factor which would indicate relation of its performance as a unit of a multi-cylinder engine. This factor was desired in order to make it possible to predict the performance of new multi-cylinder engines from single cylinder tests.

A low mechanical efficiency was obtained, probably due to the fact that two magnetos, regular oil and water pumps, regular cam-shaft drive, and a heavy flywheel were driven by this cylinder. The power required to drive these accessories is usually distributed among a multiplicity of cylinders. However, the effect of low mechanical efficiency on the power output was apparently balanced by an increase in the volumetric efficiency due to the single intake pipe, since the indicated power output was considerably greater than one-twelfth of that which is usually obtained from a 12-cylinder Liberty engine. Due probably to the increase in volumetric efficiency, the brake mean effective pressure curves do not drop off so fast, and the power curve peaks at a higher engine speed than with the standard Liberty engine.

Apparently an accurate estimate of the power of a multi-cylinder engine can be made by taking the brake horsepower developed by a single cylinder on the universal engine as the average performance of similar cylinders in a multi-cylinder engine.

TECHNICAL Note No. 48, dealing with Airplane Superchargers, a translation of an article by W. G. Noack in the Zeitschrift des Vereines deutscher Ingenieure has been issued by the National Advisory Committee for Aeronautics. The note is in multigraph form, and we believe that the Committee, whose address is Washington, D. C., have a few copies for distribution to interested parties.

When the Factory Assumes the Service Burden

The reputation of a vehicle depends largely upon the way in which it is serviced. Few service stations have been free of criticism during recent years. A factory service executive, who has had troubles in the past, tells how difficulties have been overcome by his organization.

By H. N. Davock*

IT is probably safe to say that at least half the reputation of a motor car or truck rests upon the repair service that maintains and insures its good condition for continued use. No matter how perfect the design and workmanship of a vehicle, it cannot and will not stand up long unless it is kept in first class condition by systematic inspection and adjustment. But even a very second rate vehicle can be kept going a long time beyond its normal life if well serviced. Moreover, owners of high-grade vehicles will quickly become dissatisfied, and quite justly so, if they find difficulty, delay, or excessive cost in keeping their cars or trucks in smooth running order while conversely a good running Ford hitting in all four will make its owner far happier than a noisy, rough and poorly conditioned car of higher grade which limps along with a cylinder missing.

The automobile industry as a whole has been too slow in recognizing this situation and I must include our own company in the indictment in spite of the fact that it has from the first paid very considerable attention to the matter of service. Far too often owners of vehicles have felt that neither their treatment at the service station, the work that was done there, nor the price that was charged for it were fair and businesslike. Mostly this has been due to the practices of fly-by-night service stations and garages that sprang up all over the country. They charged all the traffic would bear and they operated by methods little less than sheer robbery.

But in the unsettled condition of the automobile industry in the last few years there have been few service stations indeed that have been free from criticism. As a result there were complaints from customers that added very materially to the difficulty of making new sales. Not all of these complaints were justified, but their effect was the same whether they were fair or not.

Because of this situation the Packard Motor Car Co. about three years ago undertook a very careful study of its service stations and of the complaints that were made there. As a result it has evolved a system that has not only very materially reduced the number and volume of complaints, but has also proved of distinct service in insuring reasonable charges on repair operations in these stations. Incidentally, in many cases it has put losing stations on a profitable basis.

As the foundation for our study we worked out a list of complaints in the order of their number and importance and by careful consideration set down for each one the methods of correction which have been undertaken.

*Manager Technical Service Department, Packard Motor Car Co.

These two lists are as follows:

Customers' Complaints and Their Correction

Complaint	*Correction*
1—Work not done on time.	1—Definite scheduling system in the shop. Definite knowledge of actual time required for proposed job. Close co-operation between service office and shop regarding deliveries.
2—Work not done as desired.	2—Analysis of customers' complaints. Definite explanation by service salesmen. Definite instructions to shop for work. Definite inspection system. Supplementary orders to be issued when required.
3—Work not done properly.	3—All work on definite schedule. Inspection system in the shop to insure correct work. Education of mechanics. Special tools and time study. Thorough final inspection.
4—Charge for work more than expected.	4—Work estimated in advance. Customers sold on the necessity of all repair orders and supplementaries. Customers supplied copy of repair orders, showing estimate.
5—Charge for work excessive.	5—Customer given to understand exact nature of work. Definite estimates of expense available at all times. Equitable system of setting labor rates. Elimination of red tape, and economy throughout establishment.
6—Charge for work which should be no charge policy.	6—Service salesmen and inspectors thoroughly familiar with Packard warranty and service policies. Definite explanation to customer with regard to charge in advance. Good service salesmanship.
7—Error or delay in billing.	7—Continuous summarizing of time and material during progress of the repair. Careful check-up on completion of work. Safeguards on time and requisitions summary.
8—Discourteous, dilatory or delayed attention to customers.	8—Spirit of Packard service instilled into every employee. Morale maintained by adequate compensation, discipline and organization. Proper facilities for entertaining customers. Proper scheduling of repair jobs.

It will be seen from these lists that the complaints and their corrections occur at three distinct stages of the customers' relations with the service employees. The first is in the matter of personal relations in the approach and understanding between employees and the customers. The second is over delay or failure to live up to definite promises. The third, often a natural consequence of the other two, has to do with the feeling that the cost of the work has been excessive. Of course, all three interlock and it is often found that a reform aimed at any one of these difficulties improves the situation in regard to the other two.

The most important factor in working out the answer to this problem was standardizing the system of handling service work, but there have been some general measures in our service work that are proving of great value. The first of these and the most vital has to do with the personnel of the organization. It was evident that a very large proportion of the complaints occurred because the customer had not been properly sold either on the need of the repair work that was done or on the fairness of the charge for the work. To faulty personnel also could be traced all complaints of discourtesy and many of the complaints of delay. The successful repair or adjustment of the vehicle is only half of the job of the service department, the other half is in keeping the customer's mental attitude right. It is entirely possible to send a customer away dissatisfied even though the actual repair work has been done promptly, properly and at a reasonable cost.

Monthly or 1000 miles. ORIGINAL—Service File

VEHICLE SERVICE INSPECTION REPORT 1

DATE 19

Owner ..... Address ..... Phone .....

Driver ..... Where Inspected .....

Model ..... Body type ..... Motor No. ..... Mileage ..... Owner's vehicle No. .....

Motor should be warmed up and a sufficient road test made to report intelligently on the following points: DATE of last inspection 19

AG = ATTENTION GIVEN AR = ATTENTION REQUIRED SN = SHOWS NEGLECT

	OK	AG	AR	SN
AIR PRESSURE ..... Lbs.				
1. LUBRICATION				
(Use chart to check)				
Oil cups missing				
Grease cups missing				
2. WASH AND POLISH				
3. MOTOR				
Oil leaks				
Oil level				
Should oil be changed				
Normal power				
Compression Good ... Fair				
Bad cyls. Nos.				
Carbon and valves				
Push rods and adjustment				
Timing chain or gears				
Cylinder base nuts				
Crankcase to frame bolts				
Motor bearings				
Vibration damper				
RADIATOR, leaks				
Is radiator full?				
Anti-freeze required				
Fan and belt				
Governor and seals				
Thermostat				
Water connections				
CARBURETOR air valve drop				
Air valve stem clean				
Does choke close properly				
Throttle adjustment				
Gasoline leaks				
Hot air stove				
Pressure pump				

	OK	AG	AR	SN
OIL PRESSURE MOTOR IDLING ..... Lbs.				
Does air pressure hold				
4. CLUTCH & TRANS.				
Clutch action				
" brake adjustment				
" pedal clearance				
" shifter bearing				
TRANSMISSION oil leaks				
" oil level				
" shifter, all speeds				
Universal joints				
5. RUNNING GEAR				
Frame brackets and hanger				
Fenders and running boards				
Springs, bolts and bushings				
Shackles				
Torque arm and connections				
Radius rod and connections				
REAR AXLE, oil leaks				
" tube and flange nuts				
" worm thrust				
" carrier hold-down nuts				
DIFFERENTIAL, oil leaks				
" oil level				
Wheel, alignment				
" rear inner on shaft				
" bearings adjust				
Tires				
Foot brakes				
Hand brakes				

	OK	AG	AR	SN
AMMETER READING AT 15 M. P. H. ..... Amps.				
6. FRT. AXLE & STRG.				
Steering action				
" connections				
" cups, grease				
Knuckles, pins and bushings				
Gas and air control				
7. ELECT. SYSTEM				
Battery and connections				
Test gravity				
1 ..... 2 3				
Generator and regulator				
Voltage, both positions switch				
Starter motor and clutch				
Switches				
Lights				
Fuses				
Horn				
Ignition wiring				
" timing				
" breaker points				
" distributor brushes				
Spark plugs				
8. EQUIPMENT				
Clock				
Speedometer or odometer				
9. BODY				
Body bolts				
Upholstery				
Condition of top				
Condition of paint				
Doors				

Items checked AR (attention required) are detailed on reverse side.

Items checked under SN (shows neglect) are items for which we consider your driver responsible.

The following points show wear from lack of lubrication .....

Signed ..... Official Capacity .....

Form D-12 3M 10-21 General Pig. Co. (Over)

Selling Service

The job of the salesman is to sell service, but he is also to make sure that the customer departs with that mental satisfaction which we consider standard equipment with all of our vehicles.

Of course, satisfaction cannot be sold. It has to be earned. The service salesman's job is to see that the service station does earn that satisfaction, and that the customer knows that the service is so fair and business-like as to entitle the station to his good will. For this reason the service salesman must be an exceptional man, of good appearance, speech and all the other qualities of first class salesmanship; he must also be thoroughly familiar with Packard service policies and routine and he must not be so clever that anyone will have a doubt of his absolute squareness. Most important of all he must be the type of man who quickly makes a good impression that is lasting. He will be in touch with the owner of a vehicle throughout its life, whereas the car or truck salesman will be in touch with the man only during the brief time required in consummating the sale.

One of his particular duties is to educate the customer in regard to the cost of maintenance and repairs. Very few people have any idea of what it is actually worth to make any standard repair on a vehicle. We make it a matter of policy to see that our owners are conducted through the service stations and are given an opportunity to learn just how and why the charges are fixed on any given job. We have found that this was one of the most important of all measures in cultivating a customer's satisfaction.

Adequate Parts Supplies

The second general matter, which has to do chiefly with efficiency and speed, is in insuring an adequate supply of parts for repairs at all times, in all places, and for all vehicles that Packard has ever manufactured. This is a very considerable task, inasmuch as there are Packard vehicles well over 15 years old which are still in service and quite naturally these vehicles are likely to be among those that most frequently come in for repair.

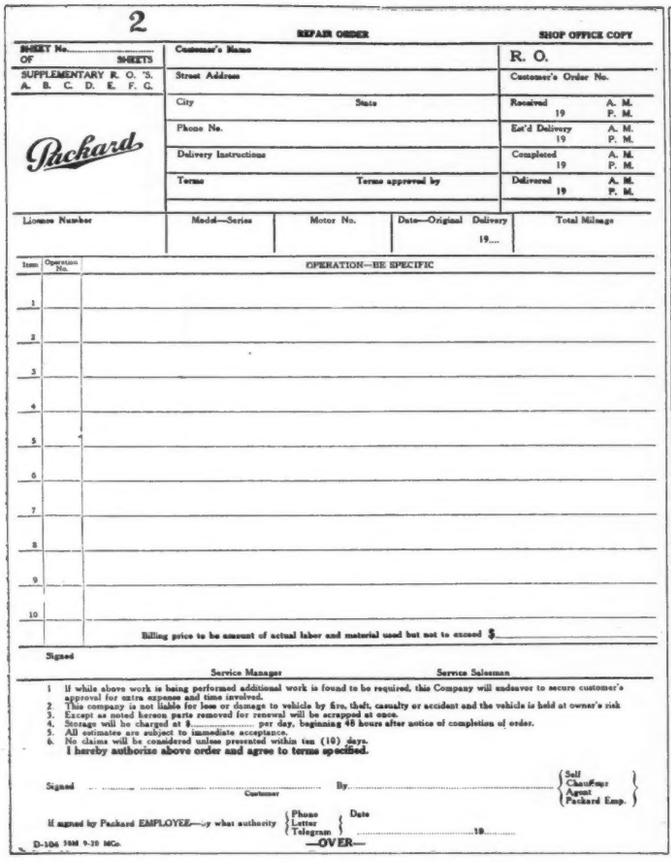
The system of providing adequate parts supply begins at the factory. We have what we believe is the only separate factory in the country devoted to manufacturing service parts. In it we have every jig, tool and fixture necessary for turning out any part of any vehicle that we have ever manufactured. We make it a point, also, to keep on hand at the service factory complete inventories of all these parts and it is our boast that we are able to fill 98 per cent of all orders on the day they are received.

In furtherance of this policy of insuring adequate supply of parts, depots have been established at various points in the country, where full inventories of all parts commonly demanded are kept. So distributors and branches who run short or have unexpected demands need not wait to get their supplies from the factory in Detroit.

Every Packard distributer is under contract to keep on hand an assortment of replacement parts varying in size from $1000 for very small sub-stations to $300,000 for our metropolitan plants in the larger cities. The Technical Service Department at the factory furnishes an accurately proportioned selection of repair parts for all the organizations. The extent to which this is carried was illustrated by a recent test made in the case of the Montreal distributer. Without notice a demand was suddenly made on his stock room for a total of 599 different service parts. The stock clerk was able to supply 598 parts.

Prices

The third general policy has to do with prices. We spent some time in trying a flat rate system of charges, but found it generally unsatisfactory, and for about



2

REPAIR ORDER — SHOP OFFICE COPY

SHEET No. ____ OF ____ SHEETS
SUPPLEMENTARY R. O. 'S. A. B. C. D. E. F. G.

Packard

Customer's Name | R. O.
Street Address | Customer's Order No.
City | State | Received 19 A. M. P. M.
Phone No. | Est'd Delivery 19 A. M. P. M.
Delivery Instructions | Completed 19 A. M. P. M.
Terms | Terms approved by | Delivered 19 A. M. P. M.

License Number | Model—Series | Motor No. | Date—Original Delivery 19.... | Total Mileage

Item	Operation No.	OPERATION—BE SPECIFIC
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Billing price to be amount of actual labor and material used but not to exceed $....

Signed

Service Manager Service Salesman

1. If while above work is being performed additional work is found to be required, this Company will endeavor to secure customer's approval for extra expenses and time involved.
2. This company is not liable for loss or damage to vehicle by fire, theft, casualty or accident and the vehicle is held at owner's risk
3. Except as noted herein parts removed for renewal will be scrapped at once.
4. Storage will be charged at $..... per day, beginning 48 hours after notice of completion of order.
5. All estimates are subject to immediate acceptance.
6. No claims will be considered unless presented within ten (10) days.

I hereby authorize above order and agree to terms specified.

Signed ..... Customer By..... {Self / Chauffeur / Agent / Packard Emp.}

If signed by Packard EMPLOYEE—by what authority {Phone / Letter / Telegram} Date .....19.....

D-106 50M 9-20 MCo.

—OVER—

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REPAIR ORDER ACCOUNTING—LABOR & COST SUMMARY

ITEM No. 1	ITEM No. 2	ITEM No. 3	ITEM No. 4	ITEM No. 5	ITEM No. 6	ITEM No. 7	ITEM No. 8	ITEM No. 9	ITEM No. 10
Est. Time	Est. Time	Est. Time	Est. Time	Est. Time	Est. Time	Est. Time	Est. Time	Est. Time	Est. Time
Emp. No. / Hrs.	Emp. No. / Hrs.	Emp. No. / Hrs.	Emp. No. / Hrs.	Emp. No. / Hrs.	Emp. No. / Hrs.	Emp. No. / Hrs.	Emp. No. / Hrs.	Emp. No. / Hrs.	Emp. No. / Hrs.
Total	Total	Total	Total	Total	Total	Total	Total	Total	Total

REQUISITION SUMMARY

ITEM No. 1 — Charge to Acct. No.	ITEM No. 2 — Charge to Acct. No.	ITEM No. 3 — Charge to Acct. No.	ITEM No. 4 — Charge to Acct. No.
REQ. NO. / Cost / List	REQ. NO. / Cost / List	REQ. NO. / Cost / List	REQ. NO. / Cost / List
Total	Total	Total	Total

ITEM No. 5 — Charge to Acct. No.	ITEM No. 6 — Charge to Acct. No.	ITEM No. 7 — Charge to Acct. No.
REQ. NO. / Cost / List	REQ. NO. / Cost / List	REQ. NO. / Cost / List
Total	Total	Total

ITEM No. 8 — Charge to Acct. No.	ITEM No. 9 — Charge to Acct. No.	ITEM No. 10 — Charge to Acct. No.
REQ. NO. / Cost / List	REQ. NO. / Cost / List	REQ. NO. / Cost / List
Total	Total	Total

RECAPITULATION

	TIME Charge Cust.	TIME Charge Acct No.	MATERIAL Cost	MATERIAL List
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
Tot.				

GENERAL SUMMARY

Sheet or Suppl.	Hours Charge Cust.	MATERIAL Cost	MATERIAL List	Flat Prices
Total				

Labor Cost ..... Hours at Flat Prices
Overhead Cost @ $..... per Hr. $.....
Shop Cost $.....

ACCOUNTING DISTRIBUTION

CREDIT	AMOUNT List	AMOUNT Cost
Car Rep'n: labor		
Car Rep'n: O. W. & S.		
Trk Rep'n: labor		
Trk Rep'n: O. W. & S.		
Battery Rep'n		
Parts sold in Rep'n		
Accessories		
Tires Tubes		
Storage		
Gas. Oil. Grease.		
TOTAL		

BILLING TO CUSTOMER

	PR. HR.	
HRS. LABOR @ $		
MATERIAL AT LIST		
MISCELLANEOUS		
GROSS TOTAL		
LESS CREDITS		
Invoice Number	NET CHARGE	
ORIGINAL ESTIMATE		

two years now have been using a system of maximum estimates. According to this method the customer receives a maximum estimate on the work to be done, with the assurance that the price will not run beyond this estimate. As the job passes through the shops careful cost accounting is done on both labor and material. If the figure thus arrived at is less than the estimate quoted, the customer is billed for the actual cost. If the work is more than estimated the customer is billed for the amount estimated and the service station stands the difference, the deficit being charged to overhead.

This system has created a feeling of confidence among customers that is very pleasing. It frequently results in a bill that is lower than the estimate given, which naturally has an excellent effect on the customer. As time goes on the margin of variation is being narrowed down by standardizing repair operations and equipment and there are many of the most common jobs on which we are now in a position to quote flat rates that are really equitable.

Checking Trucks

Finally, we have carried our salesmanship service outside the service stations, especially in regard to trucks. The truck owner usually knows nothing about his truck except what is reported to him by the driver and the driver may or may not take the time and trouble necessary to keep the truck in good running condition. If he does not, the first thing that the owner knows his truck will be laid up for major repairs which would often have been unnecessary if service had been attended to at the proper time and which will certainly cause serious interruption in his business.

To meet this we have established the policy of checking up closely on our trucks, especially during the first few months after they are put in service. During this period a service field inspector is frequently sent out by the service salesman to hop up beside the driver of a truck, sometimes take the wheel himself and make certain that the vehicle is in good condition.

Inspection Form

A complete report of each unit is made out in our standardized service inspection form, Fig. 1, which is in duplicate. The original is for the use of the service salesman, while the copy goes to the owner. A column headed "AG," meaning "attention given," indicates the minor adjustments made by the inspector. The column "AR"—"attention required"—carries the most important data, and that about which the owner is most likely to be ignorant. A letter or a telephone message from the service salesman to him tells him just how serious the trouble is, the time necessary for repairs and the maximum cost. Arrangements can then be made for having the service given with the least possible trouble to this owner.

In this way we catch trouble in its earliest stages, keep down the total repair bills and greatly increase the satisfaction that owners feel in their vehicles. Thus the inspection service gives mutual benefits, protecting truck owners against wrong usage of their property by careless drivers and protecting our own organization against repair claims by unscrupulous drivers. In addition the company has the benefit of the customer's satisfaction which results.

The system we have worked out for handling service begins the moment the car appears in the service station. We have urged that there should be a different place for handling cars and trucks and that the two be kept separate. There is a distinct difference in the personality, the needs and the attitude of car and truck users and each can most efficiently be handled in its own way.

When a vehicle arrives the customer is waited on immediately by a service salesman and taken into a neat

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SERVICE INSPECTION AND ESTIMATE REPORT

Packard

Customer's Name
Street Address
City State
Phone No.
Delivery Instructions
Terms Terms Approved by

R. O. No.
Customer's Order No.
Received 19___ A. M. P. M.
Est. Delivery 19___ A. M. P. M.
Completed 19___ A. M. P. M.
Delivered 19___ A. M. P. M.

License No.	Model—Series	Motor No.	Date Original Delivery 19___	Total Mileage

CUSTOMER'S INSTRUCTIONS

NOTE: Did customer request a complete Inspection. YES NO

INSPECTION REPORT

GAS PRESSURE Lbs. OIL PRESSURE Lbs. AMMETER @ 15 M. P. H. AMPS.

WORK ORDERED

ITEMS	Oper. No.	Work Recommended (Be Specific)	Est. Hrs.	Estimated Price Charge	Estimated Price No Charge
INSPECTION AND TEST					
1. LUBRICATION					
Renew Oil					
Oil & Grease					
2. WASH & POLISH					
3. MOTOR					
Motor Tune-up					
Carbon & Valves					
Valve Tappets					
Timing Chain or Gears					
Cylinders, Pistons & Pins					
Brgs. Conn. Rod & Main					
Cooling System					
Radiator					
Fan & Belt					
Pump & Governor					
Thermostat					
Hose					
Gasoline System					
Carburetor					
Pumps & Gauge					
Gas. Lines & Ck. Valves					
Gasoline Tank					
Lubrication System					
Pumps & Gauge					
Strainers					
Ignition (see electrical)					
		(Over) Amount Fw'd			

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INSPECTION AND ESTIMATE REPORT (Cont'd)

ITEMS	Oper. No.	Work Recommended (Be Specific)	Est. Hrs.	Estimated Price Charge	Estimated Price No Charge
4. CLUTCH		Amt. Carried Fw'd			
Plates					
Bearings					
Shifter & Brake					
TRANSMISSION					
Gears					
Bearings					
Shifter					
Universal Joints & Shaft					
Joints & Covers					
Shaft					
5. RUNNING GEAR					
Frame & Tire Carrier					
Fenders & Splashers					
Springs & Bolts					
Snubbers & Shock Absorbers					
Torque Arm & Radius Rods					
Rear Axle					
Axle Shafts & Bearings					
Differential					
Wheels & Tires					
Brakes					
Foot Brakes					
Hand Brakes					
6. FRONT AXLE					
Steering					
Controls, Throttle Gas & Air					
7. ELECTRICAL SYSTEM					
Battery					
Generator & Regulator					
Starter Motor & Switch					
Lights					
Horn					
Wiring					
Ammeter					
Ignition					
8. EQUIPMENT					
Speedometer or Odometer					
Clock					
Bumper					
9. BODY					
Upholstery					
Top					
Curtains					
Windshield					
Painting & Finishing					
MISCELLANEOUS					
		Total			

Inspector Service Salesman

and quiet office calculated to give the proper impression of the standards of the company. The salesman learns as much as possible of the customer's wishes. He is in intimate touch with the shop and advises the customer about how long the work will take and when it is the best time to bring the car in. He endeavors to make a definite promise on delivery of a job whenever circumstances permit.

If the work is of such a minor nature that it is possible to write up complete shop instructions at once and at the same time give the maximum estimate to the customer without going into details, the repair order, Fig. 2, is filled in by the service salesman. The customer signs this as a definite order for the work and receives a copy.

If it appears that some study is necessary either to determine the amount of work to be done or to fix the maximum estimate, another form, Fig. 3, is used. In a case of this kind the job is turned over to the inspector for road test and detailed inspection to ascertain just what is needed. The inspector reports back to the salesman, submitting this form filled out and the salesman then explains to the customer exactly what work is required and why it is necessary. The customer can then approve or disapprove of the order as filled out. In this manner we make certain that no work is done except on the definite order from the customer and also make certain that if necessary work is not done the customer will know that it was by his own instructions that it was omitted. Thus we eliminate two of the frequent causes of complaint; the customer will get exactly what he asks for and neither more nor less.

This form, Fig. 3, has five main functions. It is the report of the service salesman to the service inspector stating the general complaints of the owner on the vehicle; it is the inspector's report of the work he recommends to be done; it is used for compiling the maximum estimate recommended by the inspector; when approved it contains all the information used in typing up the repair order; and it is filed to serve as a permanent record of negotiations and the condition of the vehicle. As already explained this form is used only when the work is extensive enough to require either a detailed inspection or estimate.

The salesman is required to have a definite understanding with the customer in regard to the terms of payment. If credit is to be given, it must be definitely understood and approval recorded on the form. Careful attention to this with tact saves a great deal of money without any loss in the customer's satisfaction.

Delivery Promises

The salesman is not permitted to give a definite promise of the time of delivery of the car when extensive repairs are to be made, but he does estimate a time and every effort is made to meet this estimate. In making the estimate he has to consider what parts are to be used and the probable length of time required to obtain any which are not in stock, the amount of work in the shop and the general difficulty of the job. Customers can frequently be persuaded to bring their cars in for small jobs when the shop is not rushed or late in the week for work requiring several days. This matter, if handled with wisdom goes far toward keeping an even run of work through the shop with a very considerable saving of idle time.

Throughout all this part of the negotiation the salesman and inspector are particularly warned to avoid recommending any unnecessary repairs. They are instructed to show the difference between "serviceable condition" and "standard operating condition." For example, a noisy or squeaky spring is not in standard oper-

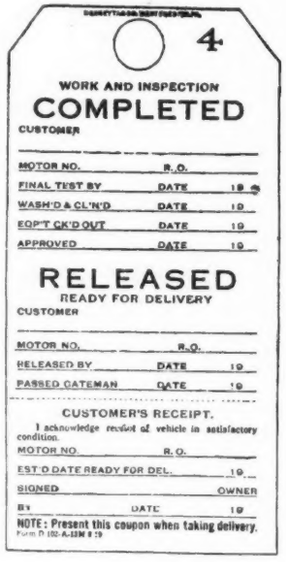
ating condition, but it is in serviceable condition. To tell an owner that a car with such a minor defect should be put in the shop for repairs would reflect on the salesman's judgment and give the customer a bad opinion of the service he is receiving from his car.

After being filled out by the inspector, the form shown in Fig. 3 is turned over to the estimating clerk for prices. This is not done in the presence of the customer, but he receives a copy of his signed order.

The cost of repair operations varies considerably in different service stations due to the variable factors, such as rent, labor costs, and so forth, and each station is urged to make up its own maximum cost estimates from its own records. Until these are available the Technical Service Department at the factory supplies tentative estimates. Where operations are not covered by the estimate book, the best judgment must be used, adding 20 or 25 per cent as a factor of safety. This is no hardship on the customer since if the work actually costs less than the estimate, he receives the full benefit of the saving.

If the order has been properly sold to the customer, the repair order, Fig. 2, a copy of which is given to the customer, is made out in triplicate. Fig. 3 is then held by the service salesman pending completion of the work.

When the repair order is filled out and the job started through the shop, a disposition tag, Fig. 4, is attached. This has three parts. The bottom part is a receipt given to the customer and when signed by him gives authority for the delivery of the vehicle to his representative. The "released" portion is turned in to the accounting department when the job is ready for delivery and it gives notice that the billing should be completed immediately. The completed portion gives information to the Service Department that the mechanical part of the transaction has been finished and the vehicle is ready for delivery. The use of tags of different colors is a silent method of informing the Service Department of the customer's financial rating; special rush jobs or other matters of that kind.


4

WORK AND INSPECTION
COMPLETED
CUSTOMER

MOTOR NO. R.O.
FINAL TEST BY DATE 19
WASH'D & CL'N'D DATE 19
EQP'T CK'D OUT DATE 19
APPROVED DATE 19

RELEASED
READY FOR DELIVERY
CUSTOMER

MOTOR NO. R.O.
RELEASED BY DATE 19
PASSED GATEMAN DATE 19

CUSTOMER'S RECEIPT.
I acknowledge receipt of vehicle in satisfactory condition.
MOTOR NO. R.O.
EST'D DATE READY FOR DEL. 19
SIGNED OWNER
BY DATE 19
NOTE: Present this coupon when taking delivery.

When the vehicle leaves the shop the gate man removes the completed tag, checks it with the coupon which the customer has given and returns both to the service sales office, where they are filed.

Owners frequently request that accessories and loose equipment be stored by the service salesman while the vehicle is in the shop to prevent loss. To meet this requirement we have devised form shown in Fig. 1, which lists all the equipment of the vehicle and serves as a checkout when the work is completed. It eliminates practically all disputes in regard to equipment or missing parts of the car.

When the car goes to the shop the shop-office copy of the repair order, Fig. 2, goes with it to the shop office. On the reverse of the shop office copy are found the time and requisition summaries which are filled out during the time the car is undergoing repairs. The successful operation of the system depends upon the correct use of this record.

1. It shows all time and material used on each item as the work proceeds, indicating at all times the state of completion of the job.
2. It shows whether the estimated time has been exceeded on any item and by how much.
   It shows what work has been completed and the amount of time and material required.
3. It provides the basis on which the cost and the charge to the customer are computed.
4. It is a detailed record of the time and material to be used in billing the job.

The form may also be used as a job setting sheet. The foremen assign men to the work in advance by the use of time slips so there need never be any time lost in transferring from one operation to another. Material is requisitioned in advance and is ready for use when needed. A standardized repair job envelope is part of the system to keep all data together as it accumulates in the shop office.

Procedure

Whether the job is completed in the shop and has passed final inspection, the shop office copy of the repair order is examined by the shop clerk to make sure there is no omission of time or material and is sent to the service sales office to be audited and billed.

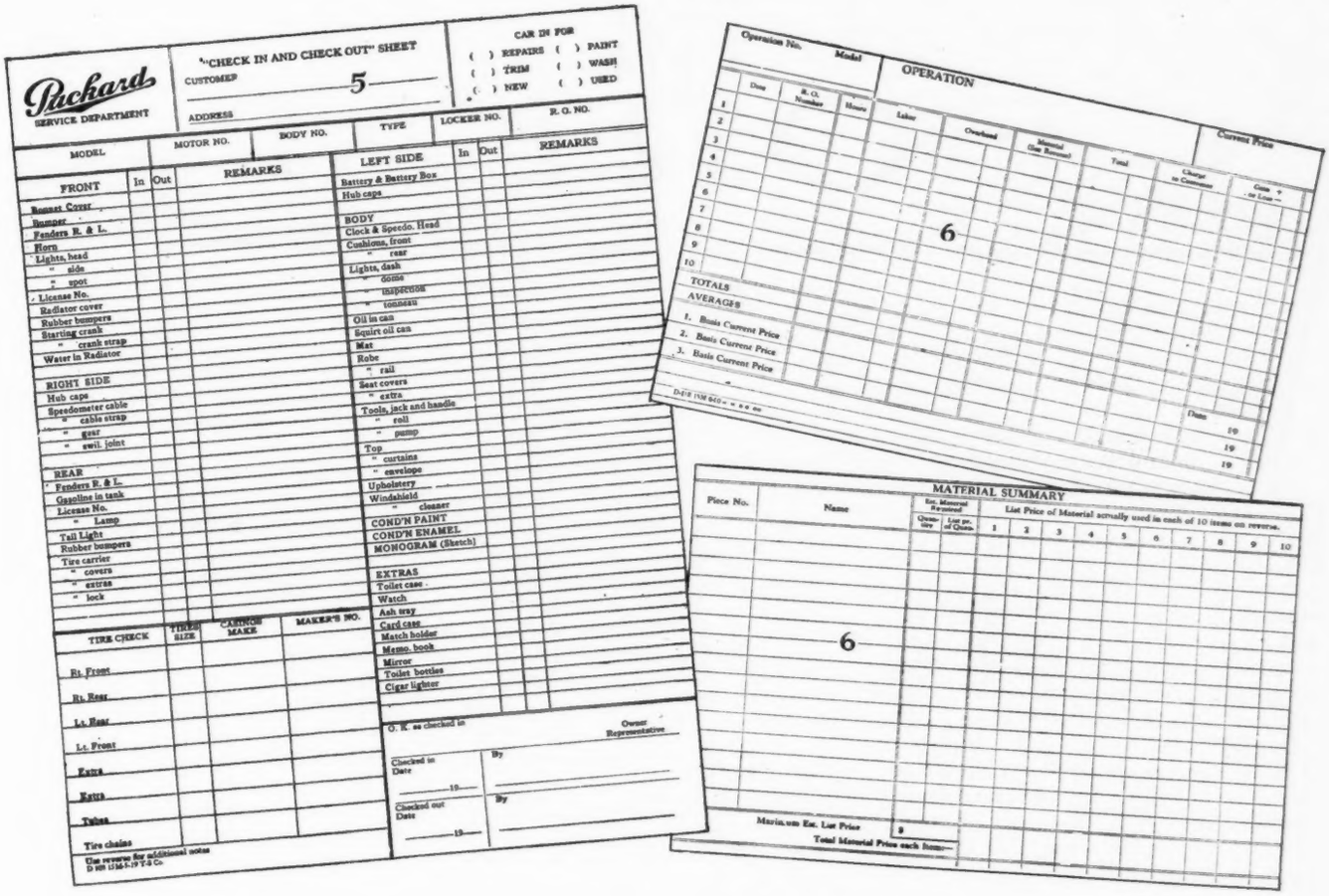
Another copy of the repair order form, the work instruction copy, is placed in a celluloid faced envelope attached to the car and goes with it through the shop. When the repair order covers more than one sheet an envelope should be provided for each sheet. When a workman has completed a particular item on the repair order he reports to the foreman, who inspects the finished work and indicates that this job is completed by a punch mark on the item number. If there is any special information which should be brought to the attention of the service salesman on the completion of the job, the item is marked with some approved sign instead of being punched and a complete written explanation is made by the foreman in the blank space on the back.

When a job has been completed in the shop it is turned over to a final inspector who checks the work and tests the vehicle. If any work is not satisfactory he should mark "rejected" on the back of the work instructions copy with notations and instructions. If he finds work is necessary which is not covered by the original, a supplementary order is issued by the Service Sales Department. It should be noted that in no case is it permitted to bill the customer for such work unless his authorization has been secured for it.

This system is outlined here only as it affects the customer. It is backed up, of course, by a complete system of time slips, stock requisitions, requests for credit and all the usual forms to insure prompt and accurate handling of the work.

When the work on the car has been finished the inspector signs in the blank "Cleared for Delivery" on the work instruction copy of the repair order and notifies the shop office clerk who checks over the accounting on the job carefully, forwarding it to the service salesman, who again checks it. The car is delivered to the service floor and a "completed tag" is attached. If the car is to be washed and polished, this is done and the car is then set in the space provided for vehicles ready for delivery, where it will be protected from damage. The service salesman holds the necessary sheets until the customer comes to take delivery.

When the customer arrives, the service salesman makes sure that the car is ready for delivery with equipment the same as when it was brought in for repairs. The customer either pays or makes necessary arrangements at the cashier's window for the release of the car while it is being brought up. When the car is driven



away the various stubs are returned to the watchman at the gate. After the job has been checked out the repair envelope containing all papers and tags connected with it is sent to the accounting department for filing.

Standardized Operations

In order to make possible our system of maximum estimates, it was necessary to standardize all operations which might be called for. To have them grouped in logical order for the sake of convenience and to avoid confusion, we have divided the work which we have to do into ten main classifications as follows:

0—Inspection,
1—Lubrication,
2—Cleaning,
3—Motor,
4—Clutch and Transmission,
5—Running gear,
6—Front Axle and Steering,
7—Electrical,
8—Equipment,
9—Coach.

Each one of these ten main headings has in turn been divided into ten or less sub-headings by means of decimals. For instance, the main heading "3—Motor" is divided into 3.1 motor general, 3.2 motor—cylinders, pistons, pins and cushions, 3.3 motor—cooling system, etc. These are again divided so that the system reads about as follows:

3—Motor—
3.3—Motor-Cooling System.
3.31—Motor-Cooling System, radiator remove and replace.
3.312—Motor-Cooling System, radiator, core renew.

It will be noted that the operation schedule has to be divided into three separate groups, each making use of the decimal classification mentioned, but with the following distinctions: Detail operations have no prefixes. Inspection operations are indicated by the capital "O" in front of each number. Combination operations are indicated by the capital "C" in front of each number.

The inspection operations are used only when the inspector is unable to decide what repairs are necessary. This applies particularly to overhauls when an internal inspection is advisable before submitting a final maximum estimate. The inspection operations cover the removal and disassembly of complete units to determine what operations are necessary for making repairs. They also include re-assembly.

The combination operations which are identified by the prefix "C" are those which call for the work necessary to disassemble and re-assemble as well as to perform the actual detail operations. This gives a simple and effective method of ordering work at the same time adhering to the standardized orders.

As a final check on this system the accounting department carries a visible index system recording the cost of operations of various kinds. This is the form shown in Fig. 6. On these cards are entered the actual cost in labor, material and overhead every time one of these operations is performed. When the card has been filled averages are taken giving a check which makes it possible to revise the current estimate.

IN Germany an anti-knocking fuel is being marketed under the trade name Hydrol. The anti-knocking element is water which is contained in soap, the soap used for the purpose being itself a fuel. The fuel is said to be saponified.

In Defense of the Air-Cooled Aircraft Engine

Editor, AUTOMOTIVE INDUSTRIES:

In view of the many broad statements regarding air-cooled aircraft motors at present finding utterance in this country, it would seem that investigation of the present state of knowledge of the many personal opinions that are bluntly put forth as facts is justified.

The writer is frankly biased in favor of the air-cooled motor, but nevertheless is not so prejudiced as to be unable to grant that water-cooling has its advantages, or that air-cooling has reached the pitch of development of its water-cooled rival.

In particular at the S. A. E. Summer meeting positive statements regarding air-cooled engines were made as follows:

By L. E. Pierce and G. J. Mead—

(1) That the parasitic resistance of the air-cooled motor is considerably higher than that of the water-cooled motor.

(2) That the reduced vulnerability of the air-cooled motor is of little practical military advantage.

(3) That air-cooling at present allowed of only relatively low mean effective pressures.

(4) That air-cooling does not allow of easy temperature control.

(5) That the weight comparison of the two types is not favorable to the air-cooled motor.

By Col. J. G. Vincent—

(6) That air-cooled engines were made in the radial form for cooling reasons rather than aircraft requirements.

It is proposed to reply to these statements.

(1) Little evidence regarding relative resistance of air and water cooled units seems to exist; if it does it is by no means widely known. These notes will have achieved something if they result in bringing before airplane designers generally definite comparisons between various types of engines cooled by both systems. The only figures the writer has been able to obtain are as follows:

(a) Engine and body resistance of RE-8 with 150-hp. R.A.F.-4A engine (12-cylinder air-cooled Vee with scoop cowl)—53 lb.

(b) RE-8A with 200-hp. Hispano engine (exactly as RE-8 except for engine, engine fairing and cooling system)—66 lb.

Both of the above are from a Royal Aircraft Factory Report and are at 100 ft. per sec. and tests on one-fifth scale models.

It has been stated on good authority that model tests have shown that the resistance of an air-cooled radial engine has a somewhat higher resistance than a water-cooled eight-cylinder Vee, but on the other hand full scale tests on the Sopwith "Snipe" and Nieuport "Nighthawk" have shown over 140 m.p.h. level flying speed at 10,000 ft., this performance in the case of the former being obtained with an engine that was not giving more than 280 hp. on the ground and probably less, which would seem to indicate that the resistance cannot be much in excess of that of a water-cooled engine of similar power.

Further it may be pointed out that the A. B. C. "Dragonfly" engine has a relatively high resistance for the power given and that an engine of similar size and resistance with high efficiency cylinders could be built to give 400 b.hp. at sea level.

It would be of considerable interest if Messrs. Pierce and Mead would produce figures and their authority for their statements regarding relative resistance.

In view of the fact that the air-cooled motor has a considerably higher mean temperature difference between the cooling surfaces and cooling air than for the water-cooled motor (between 220 and 280 deg. Fahr. mean temperature above air is an average figure for an air-cooled cylinder running with a blast velocity giving maximum power, the mean temperature depending upon cylinder size and the blast velocity varying from about 60 m.p.h. for a 65 cu. in. cylinder to 85 m.p.h. for a 150 cu. in. cylinder) and will therefore require less air to dissipate a similar amount of heat, it would seem that there is a fair expectation that the resistance will therefore not greatly exceed that of a water-cooled motor faired with equal skill.

(2) Then with reference to the statement that the "lesser vulnerability to shot and shell is of little importance as most planes that fall come down in flames." This does not agree with the views of many pilots who flew on the Western Front; many cases are on record of machines being brought down by a single shot through the radiator or water jackets (for instance, the engine from which the first official British published data on the 160 hp. Mercedes was obtained, was put out of action by a single shot through a water jacket). Further, the connection between shots through the cooling system and going down in flames seems somewhat remote.

The British, who used the stationary air-cooled engine to a greater extent than any other belligerent in the late war, had a great respect for this type of motor on the score of reduced vulnerability.

(3) With reference to mean effective pressure, a cylinder of 5⅞ in. bore by 6 in. stroke, and of American design and manufacture, has given 120 lb. per sq. in. brake mean effective pressure (29.9 in. barometer and 60 deg. Fahr. air temperature) at 1800 r.p.m., the said cylinder being as yet relatively undeveloped. It would seem in view of the fact few water-cooled engines of such size greatly exceed the above mentioned performance at such speed, that fairly high mean effective pressures are not only a matter of report.

As enthusiasm is a primary necessity for success in most mechanical fields of investigation, it would appear unfortunate that Messrs. Mead and Pierce have no real belief in the type they criticize.

(4) With reference to temperature control, there is a good deal of doubt as to whether any real difficulty exists, provided the supply of heat to the induction system be such as to maintain reasonably constant carburetion and distribution. It is the writer's experience on air-cooled engines generally, not alone the aircraft motor, that it is possible to operate over a range of as much as 350 deg.

Fahr. variation in maximum cylinder temperature without any relatively large variation in motor performance.

(5) With regard to weight comparisons, while the writer hesitates to express views on this matter, as insufficient experience is to hand to make any sound comparison, it does not seem fair to make comparisons between air-cooled engines operating on normal fuel and compression ratio and a special water-cooled motor using a compression ratio in excess of 6 to 1 and doped fuel, and further leaving the weight of water and radiator out of account (where 1.45 lbs. per hp. is quoted).

(6) Colonel Vincent's statement to the effect that "the radial form of engine was adopted on account of cooling difficulties" is in the nature of a personal opinion not borne out by investigation.

One twelve-cylinder air-cooled Vee type, giving 220 hp., produced by the British in 1917 and subjected to severe experimental test in the dynamometer and in the air, cooled as satisfactorily as any radial yet seen by the writer and incidentally a good deal better than most water-cooled engines of similar power.

The main disadvantage of the air-cooled Vee engine lies in the necessarily greater length compared to the water-cooled unit, due to the space required between cylinders on an air-cooled engine.

Experience in Europe has shown that the large Vee engine with 40 hp. cylinders has by no means unsurmountable cooling difficulties.

The writer's view of the general situation of the air-cooled aircraft motor is as follows:

Little work comparatively has yet been done on the nine-cylinder single row 300-400 hp. air-cooled radial engine; as no really satisfactory motor of such type has yet been produced, the mechanical difficulties of such a motor are by no means easy of solution and will need much careful work before the standard of maintenance and reliability set by the best water-cooled line or Vee engines is equaled.

An engine of such power will have an approximate minimum overall diameter of 48 in., and the question of cowling and fairing for minimum resistance with good cooling will call for a deal of careful design and investigation.

When experience is obtained by airplane and power plant designers and test staffs, a considerable improvement on present fairing methods will no doubt be rapidly obtained. The problem can hardly be said to have begun to exist, as large air-cooled radial engines have not been used other than experimentally and in small numbers.

By enclosing and streamlining as far as possible the valve gear and springs it is probable that a considerable reduction in head resistance can be obtained; up to the present this feature has had little or no attention.

In the light of present day knowledge it would seem that if the air-cooled motor for military work is to compete with the water-cooled engine in the 400-hp. class, the only hope lies in the high efficiency cylinder developing a mean effective pressure in excess of 130 lbs. per sq. in. and using high compression. Experience has shown that up to the present high mean effective pressure is necessary owing to the fact that the successful air-cooled cylinder has proven to be fairly heavy on a basis of weight per cu. in. volume swept. To design a cylinder of 150 cu. in. swept volume to weigh .65 lbs. per b.hp. requires considerable finesse.

The use of high compression has been shown to improve air-cooled performance, not only as regards power and fuel consumption, but cooling efficiency as well, and in this connection the use of fuel dopes allowing of compression ratios in excess of 6 to 1 gives promise of further improvement.

On single cylinder test engines, brake mean effective pressures of 135 lbs. per sq. in. have been regularly maintained, this with blast velocities lower than obtained under almost any flying condition in a pursuit machine. Such performance has up to the present only been produced under favorable conditions that would not exist on a multi-cylinder engine under service conditions, but this is likely to be balanced by the improved fuels for high compression and eradication of faults which were shown up on the cylinders while giving the above mentioned performance.

High performance from air-cooled cylinders is not obtained by the first casual idea produced on the drawing board, nor during the first run on the test block, but is the product of long and exacting test and design work.

Owing to the wide variation in climatic conditions existing between the Mexican Border and Alaska it would appear that the air-cooled has many advantages for military use in this country. It would be unfortunate if the possibilities of the air-cooled be left untried owing to an attitude of mind that condemns without investigation, and because all the problems have not already been solved. What would be the present state of aviation had the pioneers thought on such lines?

S. D. HERON,
Power Plant Section, McCook Field.

Air Operated Brakes

Editor, AUTOMOTIVE INDUSTRIES:

Permit me to congratulate you on the engineering issue of AUTOMOTIVE INDUSTRIES. I was especially interested in the article written by Bradley and Gerster, on "Four-Wheel Brakes."

To my mind, there is no question that the front-wheel brake is bound to come, although it may be confined to the better class car. The most serious objection to the front-wheel brake design is the large number of parts and universal joints which are necessary to insure correct operation at all wheel angles and spring deflections. Another handicap is the necessity of perfectly equalizing all four brakes. I may add that I believe in applying all four brakes simultaneously.

But these difficulties all disappear if a leaf is taken from the history of railroad engineering: by using compressed air as operative force on the brake shoes. Such a design eliminates all levers, joints, rods, brake equalizers, etc.; in fact, all parts which clutter up a chassis and are apt to produce rattles.

Most automobiles are equipped with a power tire pump, which would only have to be redesigned for permanent operation, and an air tank would have to be added for storage purposes. A few simple pipe lines and flexible metal hose connections would complete the layout. The brakes would be operated by opening a valve from the air pressure tank by means of a pedal or hand lever on the steering post. I have been working on such a design for the past three years, in my spare time, and have finally arrived at a practical solution of the problem. My standpoint on this question seems to be confirmed by the brake design of the Hispano-Suiza, where the car itself supplies the power for applying the brake shoes.

It seems to me that a discussion by the engineering fraternity on air-operated brake design would be of benefit to the automobile industry.

E. H. DELLING, Chief Engineer,
STANLEY MOTOR CARRIAGE CO.

A MEETING of the Executive Committee of the American Engineering Standards Committee was held at Washington some time ago to discuss the possibility of securing government support for the valuable work which this committee has in hand. Representatives of engineering societies and Government Departments attended.

Knowledge Is the Beginning of Understanding

It is necessary for the manufacturer to have knowledge of the workers' viewpoint if understanding is to be reached. He should welcome good suggestions regardless of their source. Mr. Tipper discusses a speech recently made by a labor leader and recommends it for examination.

By Harry Tipper

IN the Editorial Section of the New York *World*, Sunday, June 19, there was a speech by John H. Donlin of the American Federation of Labor, which contained many interesting statements. A good many of these statements would agree almost in their entirety with remarks made by many of the industrial leaders.

On the question of production, for example, Mr. Donlin very definitely agrees with the necessity for more production and for greater efficiency in production:

> "Wealth cannot be distributed until it is produced, and the more we produce, and the more efficiently we produce, the richer we will be, the more our dollar will buy; the less we produce, the dearer it will be and the less we can buy."

On the question of production and the necessity for foreign commerce, Mr. Donlin's statement is equally interesting:

> "Labor, capital and management must co-operate, must recognize mutual responsibility. To keep everybody working, upon which hinges the well-being of the masses, we must keep our factories running at full blast. We must export merchandise which can only be sold in foreign markets in competition with native products. The thing that recommends the purchase of our goods is the price, and if the American standard of wages will prevail, a standard of efficiency must previal in accordance."

Perhaps the most interesting statement which he makes, because of its unusual source, is the statement regarding strikes—jurisdictional strikes, which are very frequent in the building trade and which are hampering that industry very seriously:

> "My experience in this movement at least has taught me one thing—that jurisdictional strikes generally are the result of demagogues and aspirants for office, or they emanate from a class of workers which it is impossible to satisfy, or for reasons that will not stand for the magnifying glass. When it is all summed up, we can attribute it all to selfishness and absence of justice, equity and fairness. Only those organizations will endure which correct abuses, make reforms, eliminate contentions, create amity, mutualism, a feeling of mutual dependence among men."

This speech, printed by the *World*, reached a great many people, but it is questionable whether it was read by anyone not in sympathy with the labor union movement, outside of a few students who are willing to read material on the subject from any source.

Unfortunately, it is still true that we approach the human question in industry pretty much in the same way that we approach the question of our political party. Very few Republicans I know read Democratic newspapers and documents, and only a small number of my Democratic friends have anything to do with Republican information. It is quite unusual to find a man in industry, with the responsibility of management, who will read the prepared definitions of the labor leader or who will approach his reading of them with a desire for information.

> **Several years ago, when I first started active work in the analysis of the human difficulties in industry, I made a number of addresses before groups of manufacturers. Very frequently many of them were there simply to find out the weak spots in my argument and to tear down, if possible, the structure I was building up. They were not in sympathy with the discussion of the matter, and they did not want to have any new ideas interjected into their beliefs.**

We have come a considerable distance since that time and there are many matters openly and generally discussed that were avoided in those days, although that is only a few years ago. We are not yet at the point, however, where manufacturers on the one hand and the labor leaders on the other are willing to read what may be written or said upon this subject without regard to its source and its probable affiliations.

This tends to slow up the whole movement toward a better understanding of the factors involved in the difficulty; it perpetuates the errors and the prejudices; it lends strength to traditions which have nothing more than custom to justify them.

Here is an important leader of labor in a trade which has been heavily involved in strikes and interruptions, where graft has been rampant between the labor leader, the supply man and the contractor, and where the extortion has been generally suspected, if not openly admitted. The terms in which this leader speaks indicate that he is endeavoring to draw the building trade unions into a more sensible, normal and just method of dealing with the problems. Unless his words are utterly at variance with his actions, he believes the present situation is due just as much to the iniquities of labor as it is to the iniquities of the employer.

Under such circumstances the statements of this leader should be welcomed by the leaders of the manufacturers' organizations in the field, the agreement in their viewpoint should be publicly admitted, the extent of their agreement should be publicly emphasized, and, on the basis of that public commitment, a program of constructive development should be erected.

This has not happened. No encouragement visible to the observer has been given to the constructive address delivered by Mr. Donlin before the American Federation in its convention. On the other hand, this address has undoubtedly stirred up the radicals within his own organization, and they will find in it plenty of text to prove that Donlin is deserting the cause of labor to some extent and compromising with capital.

Some manufacturers have lost an opportunity at this time to start the machinery for the solution of problems that are very severe and that have worked to the detriment of the whole building trades movement.

No man who is charged with the responsibility of an investment of millions of dollars and the government of thousands of workmen is fulfilling that responsibility if he neglects to keep himself informed on the best ideas in labor and the tendency of the most constructive thoughts in labor circles.

Because the American Federation of Labor represents the largest body of organized development in skilled labor circles it is to be expected that some of the leaders in that movement are thinking constructively of its future and its future necessities.

I may not believe in labor unions *per se*, but the character of my belief in that matter does not affect the necessity for my understanding of the labor union, its tendencies and the development of its best thought.

Constructive and logical suggestions do not appeal to the majority at any time. The labor leader who offers constructive and advanced ideas is not likely to be followed by the rank and file of his union. He must fight for these constructive ideas within his own organization and fight a discouraging battle for every future move. The same thing is true in manufacturers' organizations.

When the men of most constructive character and thought in the management of industry and the organization of labor approach each other so closely in their understanding of the necessities, the agreement should be emphasized. The foundation of common understanding should be seized upon to provide a basis on which the constructive development can be erected.

In the last paragraph of Mr. Donlin's speech, which is the third paragraph quoted in this article, he is very illuminating, and few executives in the management of industry but will agree with his description of the trouble and the solution.

I recommend this document as interesting material for the man who has at heart the solution of the present human difficulties interrupting the progress of industry.

Thirty Years' Constant Service from One Car!

THIRTY years' constant service is the record of the twin-cylinder Panhard-Levassor car with which Abbe Gavois, a village priest at Rainneville, near Amiens, entered Paris recently amid the plaudits of an enthusiastic crowd.

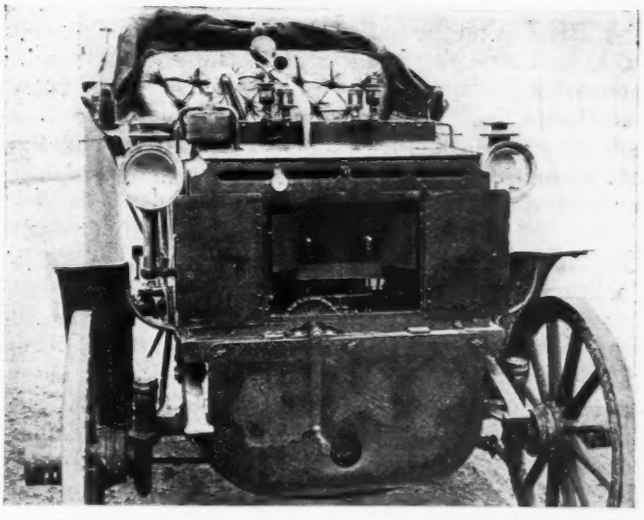
In December, 1891, this high-wheeled, tiller-steering, 3-hp. automobile came out of the Panhard-Levassor factory, bearing serial number 8. It was purchased by the mayor of Troyes, who, after a couple of years' service, sold it to Abbe Gavois, its present owner. For nearly twenty-eight years the ancient Panhard has been used by the priest for visiting distant parts of his parish, and during that time it is estimated that it has covered 100,000 miles without ever going more than 100 miles from home, and without ever having attained a speed of 15 miles an hour.

During the war the old car remained on the battle-front and was used by the priest for his journeys among the troops and to visit the few parishioners who had refused to move to the rear. The German troops took possession of the village in 1914, but were not interested in the relic or its owner. When they fell back from their rush on Paris the car was put on the road again by special permission of the general commanding the British troops holding this section of the front.

The end of the war found the old Panhard and its sturdy owner in excellent condition, in strong contrast to the devastated country around them. After having refused several pre-war offers to sell "the ancestor of the automobile industry," Abbe Gavois resolved, a few weeks ago, that he would part with his almost lifelong friend and give the proceeds to a fund for the relief of the war-stricken inhabitants of his parish.

The offer of the Panhard-Levassor Company to bring the old car to Paris on an automobile truck was indignantly refused by the priest. After lighting the hot tubes, the ecclesiastical motorist climbed up behind the steering tiller and at 4 a. m. set out on the last journey to Paris, 95 miles away. He slept just outside the city that night, and the following morning made a triumphal entry through the gates of the capital, paused for an instant in front of the monument erected to the memory of Emile Levassor, the builder of the car, then rolled down the Avenue de la Grande Armee and the aristocratic Champs-Elysées to the showrooms of the Panhard-Levassor Company, where the car was placed on exhibition prior to being offered for sale by auction.

The veteran has two cylinders of 70 by 110 mm. bore and stroke, automatic inlet valves, hot tube ignition and wick carbureter. Its timing gears and its change speed gears are exposed, its clutch is of the now obsolete brush type, and final drive to the steel-shod wheels is by a single chain, the tension of which is regulated by moving the axle and springs. In 1912 the car was completely overhauled by the Panhard-Levassor Company, without being modernized in any way.



Panhard-Levassor car reported to have seen 30 years' continuous service. Is thought to have traveled 100,000 miles without exceeding speed of 15 m.p.h. Has two-cylinder, 3-hp. engine with hot tube ignition and wick type carbureter

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Commercial Bribery

A BILL is on the national legislative calendar which is interesting to all commercial enterprises, but concerning which little has been said. It is known as House Bill 5632. It provides punishment for any employee, partner or officer of a firm who shall accept bribes or gratuities unbeknown to his employer or business associates.

This bill has been promoted by the Unfair Competition Bureau of the Paint and Varnish Industries. The facts on which the need of this bill are based have been known to many industries for a long time, but were written into records by the Federal Trade Commission. It has been shown in hearings that it was a frequent occurrence for varnish and paint firms to pay certain employees of customer firms a definite amount per gallon of material purchased. The better firms have objected to this practice, and at present practically all firms in this industry have signed the fair dealing code. It is also told that certain oil companies have maintained card indexes of employees of customer firms and the price they demanded for recommending the various oils sold by this firm.

The automotive industry is a heavy purchaser of varnish and oils and this industry may well be interested in this pending legislation.

Lubrication of Chassis Parts

THERE are evidences that more attention is being given to ways and means for providing better lubrication of chassis parts, or what is more to the point, decreasing to an absolute minimum the number of parts which require hand lubrication. Experiments are being made, for example, with flexible members for use in place of spring shackles, and many manufacturers are investigating various types of oil-less bushings which appear promising.

There seems to be a quite general agreement that the grease cup will in time disappear from the passenger car chassis. It is at best a messy job to fill a grease cup, and too often the grease is not forced to the surface it is intended to lubricate. As a result, rapid wear with consequent rattle takes place and the parts affected require early renewal. Those systems which force grease under considerable pressure to points where it is required are a considerable improvement over the ordinary grease cup, but even with this system lubrication is often neglected, and grease is at best a poor lubricating medium. It is sometimes referred to as a sponge for carrying the oil which gives it the only lubricating value which it possesses, and the oil is not always released until heat generated by friction causes the grease to flow, and wear may then have taken place.

Several car manufacturers and one or two parts makers have designed systems for feeding oil to all points of the chassis requiring lubrication, but the cost and complication of these systems is a serious drawback to their general adoption. Devices arranged to feed oil by wick or as a result of vibration are promising, at least for certain applications, so long as they are made readily accessible for filling, cleaning and adjustment.

The whole subject of chassis lubrication is one deserving of further study. It has an extremely important bearing upon the convenience and cost of upkeep, as well as upon service, and there are few more important items than these demanding the attention of car and truck manufacturers to-day.

Pollyanna for President

THE pessimist has been much condemned lately. His baneful influence on business conditions has been recognized and he has been very properly squelched when he attempted to sing his song of gloom. But there is a type of professional optimist whose influence is just as evil.

This is the sort of optimist who closes his eyes to facts and implies that all must be well simply because he says so. He is the type of salesman who sits around the salesroom with a cheery smile, saying business is good, despite the fact that he hasn't made a sale for a week.

A sincere regard for facts does not necessarily im-

ply pessimism. Sane optimism finds its very foundation in facts, however doleful the facts themselves may appear. Optimism is no relation to foolhardiness. A recent advertisement in *Printers' Ink* expressed the truth briefly and forcefully. We forget what the advertisement was advertising, but that doesn't matter. Under the heading, "Grin, But Don't Bear It," this advertisement said:

"Would you like to hold stock in a company with Pollyanna as president?

"The disposition to grin is useful, perhaps, but one must know how to handle it, especially in business. A knowledge of all the facts is really more useful."

A careful search for facts and an intelligent interpretation of those facts may be more difficult than merely grinning, but it will be more productive of results as well.

A Transportation Project

THERE are movements of a local nature which have a greater significance than appears on the surface. Such is the present movement on behalf of a bridge across the Hudson River, which will connect Manhattan by a direct open-air route with New Jersey. Previously all transportation for motor cars across the Hudson, south of Poughkeepsie, has been subjected to the inconvenience of more or less efficient ferries. Recently the building of a tunnel from Manhattan to New Jersey was started and doubtless will proceed. But, in the words of a veteran and enthusiastic motorist, "Who wants to ride in a dark and smelly tunnel?"

The Hudson River bridge project was started in 1873 or thereabouts under the direction of Gustav Lindenthal, who has a position all his own in bridge building. Mr. Lindenthal has been connected with the movement from that time on. The first plan was for a railroad bridge, and once its building was authorized. Necessary economies, perhaps a lack of vision on the part of some men in his places, and other reasons have kept the project back.

Only recently the project has been revived, and the space allotted to vehicular traffic has been greatly enlarged. Practically every bridge engineer in the world has expressed his views, and, under the direction of Mr. Lindenthal, these views have been coordinated for safety and utility. The array of engineering names behind this project does not leave much doubt as to the thoroughness of the preparation.

It is said of this bridge that it will carry traffic equal to twenty tunnels, and, despite the high figure given for its cost, will cost only half of the total for the twenty tunnels.

The project at present is proposed as one for private enterprise. It is suggested that, with the proper introduction to the public, bonds can be sold to build the great structure. The railroads and similar interests are committed to it. As a first step toward the carrying out of the project, the Hudson River Bridge and Terminal Association has been organized. This is practically a promotion plan for the bridge project. Many men and business organizations have joined this Association, paying a fee of $100. This Association will organize the bridge building project.

It is suggested to the automotive industry that an enterprise of this sort means much to the industry. It would greatly add to the value of a vehicle owned in the lower Hudson River community. It would be a precedent for similar work in Philadelphia and other river-bound cities. The sale of only one car would repay the factory or the dealer for his outlay in this connection. Those interested can obtain further information from the Association at 7 Dey Street, New York City.

Stabilizing Business

"HOW is business?" was asked of a parts maker the other day. "Jumpy," came the reply. "We can't make any plans; can't actually get into production or begin to build up our organization. Orders come in one day and are cancelled a week later. We have one good week, then a bad one." The quotation is typical of business at the present time. It is interesting to attempt to analyze the reason for such a condition, not only because it is specially acute just now, but because it is always more or less true of our modern industrial organization.

If the manufacturer knew for certain how many people were going to buy one of his cars during the next twelve months, it would be a comparatively simple task to order material and route production accordingly. But it is impossible to ascertain such facts accurately. Obviously, however, the more nearly accurate sales estimates are made, the more steady and economical will be the factory production. And while it is not possible to determine a sales figure to the last digit, it is perfectly possible to make a closer estimate than is commonly done.

The factors of merchandising have never been analyzed and examined as carefully as have those of engineering and production. Mechanical knowledge has progressed at a rapid rate during the last twenty-five years, but merchandising methods have failed to keep pace with that advance. Sales analysis proceeds upon scientific lines only in a few cases.

More attention in the future must be paid to determining sales possibilities, to territorial analysis, to discovering the factors involved in selling, and the relative value of those factors to one another. The psychological aspect of the merchandising problem must be studied and intensive work must be done in merchandising and commercial research. A few manufacturers are going forward along this line; others will follow.

The lack of knowledge of markets and of selling possibilities has a far-reaching effect in modern industry. So closely related are the various units that the failure in one department of one company may vitally affect thousands of persons and scores of other companies. Both enlightened self-interest and the recognition of a moral obligation in industry call for strenuous efforts along scientific merchandising lines.

Send in your name for a copy of Index of Vol. XLIV of AUTOMOTIVE INDUSTRIES.

Parts Factories Short of Orders

Makers Expect Dull Two Months But Are Optimistic About Future

NEW YORK, JULY 5.—Makers of the most important component parts which go into the manufacture of automobiles are conservatively optimistic about the future. They have no illusions regarding the next two months, and they state frankly that they have few specifications on their books for July, with virtually none for August. In view of this situation and the probable slump in retail sales for the next eight weeks, it is highly probable a considerable number of parts plants will be virtually closed for a month or more while awaiting fall orders.

The optimism is based on the firm belief that the worst of the period of readjustment is over and that after the next sixty days, conditions will gradually improve. As the representative of one big company phrased it: "I don't look for much business before January, but business may surprise us and we may have much more than we expect long before that."

A good many parts factories got more business the latter half of June than they expected and they frankly admit that the same happy condition may prevail the rest of the year. They are convinced that fundamentally the outlook is better than it has been for eighteen months. This is true not only in the United States but in Europe as well.

As a matter of fact the European situation is one of the most encouraging features. Germany seems to have settled down to a grim determination to meet the reparations terms. The British coal strike has been settled and a strike in the British engineering trades has been averted. The Silesian tangle is being straightened out and there is a stronger prospect than there has been for years for a satisfactory solution of the Irish problem. The new tariff which Congress will adopt promises to be the biggest stumbling block in the way of foreign trade.

Falling Prices Checked

In the domestic field there also are numerous encouraging factors. The chief of these is found in the fact that the precipitate fall of commodities seems to have been checked and while many readjustments remain to be made, prices have been stabilized to a certain extent. The new tariff probably will bring a gradual upward trend in some fields and these advances probably will be reflected in retail prices, especially of food products, which still have a long drop to make before they will adequately reflect the decline in wholesale prices.

The crop prospects generally are gratifying and the fact that in several European countries the harvests will be shorter than had been expected, will increase export demand. The new tariff was framed specifically to aid the farmers. These two factors should tend to break down the sales resistance in the agricultural sections and enable the farmers to liquidate some of their bank loans. Conditions also are improving gradually in the south and business certainly is no worse than it has been reported, especially in automobiles.

In the industrial sections unemployment probably will increase somewhat during July and August, but this is the normal mid-summer condition and there is every reason to believe that it will be preliminary to a slow but steady march forward after the middle of September.

June Sales Amazing

An amazing sales record was made in the retail automobile field for June and in most districts the volume of business ran ahead of May and even of April. There are no indications yet of a July slump but sales are not likely to continue at the pace set last month.

Parts makers are the first to feel a slump and the first to recover from it. For that reason there is reason to believe that within sixty days their plants will be running on a better basis than they dare hope for now. Their June business ranged from 25 per cent. to 50 per cent. of that done in May.

NEW RECORD FOR FORD WITH 4360 CARS A DAY

DETROIT, July 5—The Ford Motor Co. set a new high record for monthly production with an output of 108,962 cars and trucks in June in the Detroit factory and 22 assembly plants throughout the country. Production has been increasing steadily since early spring and shows substantial gains over the same period last year.

The second quarter of this year shows an output of 301,796 against 220,878 for the same period last year, a net increase of 80,918.

Despite the fact that the plants have been running at maximum capacity, the demand for products is not being met, officials say, and there are many thousand unfilled orders ahead so that Ford sales are still limited by manufacturing facilities rather than marketing possibilities. This is true particularly with respect to closed cars, for which the demand is unusually heavy.

The estimated output of the Ford company for July is 109,000 cars and trucks, or a production approximating 4360 daily for 25 days. Since the assembling of cars is handled during an eight hour work day only, the hourly output will be approximately 545 cars. In other words, one Ford car or truck will leave the assembly line every six and a half seconds.

Two Measures Cover Truck Dumping Evil

Section of Permanent Tariff Provides Duty—Graham Resolution Hits Speculators

WASHINGTON, July 1 — Two measures to prevent reimportation of American made trucks are now pending before Congress. Chairman Fordney of the House Ways and Means Committee says Section 317 of the permanent tariff bill fully covers this important issue. Congressman Graham of Illinois has a joint resolution before the Ways and Means Committee which would practically prohibit reimportations and favorable action on the resolution is promised by Chairman Fordney as a means to expedite this legislation.

Section 317 of the tariff bill reads as follows:

"That upon the reimportation of articles once exported, of the growth, product or manufacture of the United States upon which no internal tax has been assessed or paid, or upon which such tax has been paid and refunded by allowance or draw back, there shall be levied, collected and paid a duty equal to the tax imposed by the Internal Revenue laws upon such articles, except articles manufactured in bonded warehouses and exported pursuant to law, which shall be subject to the same rate of duty as if originally imported, but proof of the identity of such articles shall be made under general regulations to be prescribed by the Secretary of Treasury."

If this item is included in the permanent tariff when finally enacted it will put an end to underselling the American market by speculators who have purchased army trucks abroad at ridiculously low prices.

Because of delay incident to the debate on the tariff bill the Graham resolution may be rushed through the House and Senate. It provides for an assessment of 300 per cent on reimportation of war supplies, based on American valuations. This rate is sufficient to equalize prices in this country and halt the flood of remanufactured or altered trucks sold by the army agents which found their way into the hands of speculators.

NEW DILUTION GAGE

CHICAGO, July 2 — An instrument for determining the dilution of crankcase oil has been placed on the market by the Lubricating Appliance Mfg. Co. under the name of the Larcliff Dilutometer. It is in the form of a hydrometer on the stem of which there is a sliding tube with scale marks lettered "Danger," "Poor," "Fair" and "Good." The sleeve is set so that new oil will show "Good," and the scale mark to which the instrument submerges then indicates the degree of dilution. Tables for different oils have been worked out for the use of the operator.

Reserve Board Finds New Prices Paying

Fair Profit Shown by Leading Companies but Smaller Makers Suffer

WASHINGTON, July 5 — Bankers throughout the country are watching the effect of the recent price reductions in the automobile trade with interest. The survey of general business and financial conditions for June as completed to-day by the Federal Reserve Board shows that the month has been relatively quiet and of temporary reaction marking the close of spring demands while arrangements for autumn trade have not been completed. Prices in all lines tend more toward stability and the downward movement during May was the smallest since the decline first began. One of the encouraging signs is the recovery of agriculture, though there is some hesitation in buying.

Discussing the automobile situation, the Federal Reserve Board says:

"May shipments of automobiles by factories producing three-fourths of the total output of the country show a falling off from the April figures. May shipments amounted to 18,608 carloads, as compared with 20,087 carloads during April, although driveaways increased from 14,197 machines in April to 15,200 machines in May. Thus far this year carload shipments have been greater than last year only during April, but driveaways have been much less in every case and during May were only slightly over 20 per cent of the May, 1920, figure.

"Manufacturers of popular standard makes who build their own cars are able to make a fair profit and do a good business at present prices, but assemblers, as well as some of the smaller and weaker companies find their overhead increasing as competition to supply the restricted demand becomes keener."

Dyneto Renames Officers; Finances Show Gains

SYRACUSE, July 5.—Charles L. Amos has been re-elected president and chairman of the board of the Dyneto Electric Corp. Others returned to office are Vice President H. B. Leary; Secretary John C. Boland, and Treasurer Jacob B. Stemmler. Directors re-elected are Charles L. Amos, Jacob Amos, John C. Boland, Jacob D. Stemmler, George H. Dennison, James G. Grant, all of Syracuse; R. M. Owen and H. B. Leary of New York and H. M. Ballard of Chicago.

The committee of creditors created Nov. 20 by order of Judge Ray in United States court will continue, the stockholders' action not affecting the work of the five men named to conserve assets of the corporation. The company is slowly throwing off the financial difficulties which forced creditors last fall to begin a friendly suit in equity, according to the statement made by one of the committee.

The five men named on the committee are members of the board of directors. They are Percy H. Ridings, E. A. Hardman and C. Hamilton Sanford of Syracuse, and H. W. Barnard of Rome and William E. Lowther of New York.

When the court order was made last fall, liquid assets of the corporation were $1,552,550.36 and liabilities $690,037.39 with the business ordered aggregating more than $8,000,000. The financial difficulties were attributed to the slump in automobile manufacturing and failure of sales to materialize.

Federal Conflict Follows U. S. Tax on Manufacturers

RALEIGH, N. C., July 5.—While attorneys are advising one or another of the 92 automobile manufacturers liable for the $500 tax recently invalidated by the United States Supreme Court not to pay this tribute, State Treasurer Lacy is sending out letters calling for the payment of this state tax, and there is another North Carolina federal conflict.

Treasurer Lacy is proceeding under the advice of Attorney General Manning, who reads the highest court's opinion as no bar to the recovery of the tax imposed upon these outside dealers. Judge Manning thinks that the Supreme Court merely invalidated the discriminatory section and makes all dealers equal.

The last session of the general assembly put in a proviso making the act applicable to all alike, if there was any trouble about it, and Attorney General Manning, after quoting that section, says:

"The effect of this provision, in the light of the decision of the Supreme Court of the United States is to strike out from section 72 of the revenue act of 1921 the proviso which, under this opinion, discriminates against non-resident manufacturers, and to leave the remainder of the section intact. Thus, in the opinion of this office, you should continue to collect the license tax of $500 from those engaged in the business of selling automobiles and automobile trucks in the state, and you must likewise collect it to the full amount from those resident manufacturers who have heretofore paid only $100."

TULSA AUTOMOBILE SOLD

TULSA, OKLA., July 2—The plant of the Tulsa Automobile Mfg. Co. has been sold to D. M. Witt of Oklahoma City by R. M. McFarlin and his associates. Floyd Thompson, former sales manager of the company, will be interested with Witt and will be manager of the Witt-Thompson Motor Co., which will be the new name of the concern. The company has dealers in California, Oregon, Washington, Missouri, Colorado, Arkansas and Oklahoma, and an export department in New York. The new company takes over all the assets of the old but none of its liabilities.

Sales Continue High As Summer Sets In

June Business in New York Equals Expectations—Look for Good Season

NEW YORK, July 1—June has closed with both retail and wholesale sales of passenger cars in the New York territory running strong. Several medium priced cars have run far ahead of their April and May records and a large number of cars which were not selling at all in April and May, because they had not yet reduced prices, have had brisk sales, with the result that the total of June sales and deliveries will be the largest for the year.

Despite persistent rain sales have not shown any decided falling off as the month has drawn to a close and there has been no indication of any July and August slackness beyond that which is normal when large numbers of automobile owning people are away on their vacations.

Buick has closed its June books with the second largest month in the history of the New York branch. The record month was in 1918 but it exceeded the business of the past 30 days by only a few cars. Franklin's June was better than 1920. Oldsmobile exceeded its May record and almost equalled the heavy sales of April, business in the territory outside New York City being especially good. Maxwell's sales curve has climbed steadily through April, May and June.

There are a few cars which have not sold well and several of the high priced makes have had some slowing up, as compared with their April and early May records.

In general dealers are agreed that business is good.

Used car demand is brisk but buying is extremely close.

STARK-INLAND ASKS MORE TIME

ST. LOUIS, July 5—Creditors of the Stark-Inland Machine Co. have been asked to grant an extension of six months on their accounts. The business of the company is said to show a substantial profit and the promise is made that any sum above the actual running expenses will be used in the cutting down of obligations. Creditors whose claims are less than $100 will be paid in cash. The bank which is the largest creditor is said to have agreed to give such financial assistance as may be necessary for the proper conduct of the business if the other creditors will grant an extension of time.

ROSE GUARANTEES PRICES

HASTINGS, NEB., July 5—The Frank Rose Mfg. Co., manufacturer of Rose specialties, has guaranteed its prices up to Jan. 1. Dealers have been informed that if manufacturing costs can be lowered all stock purchased after July 1 will be protected up to Jan. 1.

Army Truck Disposal Opens Way to Sales

Future Markets Being Created As Vehicles Exemplify Value, Declare Officials

WASHINGTON, July 1—Distribution of surplus trucks, passenger cars and tractors from the army to the various highway departments has stimulated sales and developed service rather than retarded the trade, according to the opinion expressed to-day by officials of the Bureau of Public Roads. Emphatic denial was made that the Government had distributed unserviceable motorized equipment to the States, and it was pointed out that all unserviceable vehicles were sold under the auspices of the Motor Transport Corp.

The Federal agency stated that no highway equipment was dispatched to the State highway officials except upon requisition and after a complete inspection and report had been submitted. The Bureau of Public Roads will have approximately 4000 army trucks of varying sizes and 1800 passenger cars to dispose of under the terms of the Army Appropriation Act, which went to the President for his signature last week.

It is the contention of Government officials that the automobile industry, as a whole, particularly the motor truck division, has materially benefited from the distribution of surplus war material. It is stated that handing out approximately $80,000,000 worth of samples must eventually bring returns to the manufacturers and dealers. As an illustration, it is declared that one American truck manufacturer had restored confidence in his product by the development of service in the various states where the equipment had been placed with the highway commissions.

This motor vehicle had been condemned as inefficient for several months prior to the armistice, but it soon proved its worth when put to domestic uses. In fact, one state which had accepted the consignment of trucks, reluctantly, finally adopted it for standardization purposes, and has expressed a preference for the models manufactured by this particular firm. It is further declared that these trucks actually in use and giving as satisfactory service as could be reasonably expected because of their present physical condition, make it easy for a truck salesman to sell newer and improved models to the state.

87 Per Cent Now Delivered

The statement of allotments and deliveries of trucks, Fords and other automobiles from surplus war materials to the several states and retained by the Department of Agriculture to June 1, 1921, shows that the deliveries amounted to 27,983 vehicles, of which 21,115 were trucks delivered; 2770 Fords delivered and 433 other automobiles, making a total of 24,318 vehicles, or 87 per cent, delivered.

WHIP FACTORY QUITS AS DEMAND SLACKENS

WESTFIELD, MASS., July 2—The coming of the automobile has made such serious inroads on the whip industry that the United States Whip Co., the largest factory of its kind in the world, has suspended operations. The company has been operating on a four-day basis.

Ohio to Seek Repeal of Truck Weight Limit

CLEVELAND, July 1—State Senator J. F. Burke of Elyria, gave his pledge to the Cleveland Automotive Trade Association at a meeting in the Hotel Winton that he would lead a fight at the next session of the Ohio General Assembly to restore to Ohio highways the 14-ton maximum of truck and load combined.

A measure passed this year limits the weight to 10 tons. The Cleveland organization joined with the State and other kindred bodies to fight the measure, and delegations asked the Governor not to sign the bill. The executive approved it, however.

Senator George H. Bender of this city, also promised to give his aid to the movement, as did E. J. Shover, secretary of the State association.

The action in this city is the opening gun of a battle that will be waged against the bill by all automobile trade associations in the State under the leadership of the State body. Senator Burke, Shover and other speakers declared that the measure was discriminatory; that it would cause thousands of dollars worth of trucks to be put out of commission, and that it was a serious handicap to the motor transportation facilities of the commonwealth.

Construction Costs on Highways Decrease

CHICAGO, July 1 — State contracts for 29 miles of concrete roads on the Chicago-St. Louis route have just been let at a marked reduction from the first bids received and refused because they were excessively high. The awards show a drop in the price of cement compared with the bids of last February of 14.4 cents a barrel, or of $476 a mile.

Governor Small, it is said, still considers the bids too high but expresses satisfaction that the figures are well within the $30,000 limit set by his office.

FRUIT GROWERS USE TRUCKS

INDIANAPOLIS, July 1 — William Guinot, distributor in Southern California for the Swinehart Tire Co., was in Indianapolis this week. He says the fruit growers of his territory are solving their own freight rate question by using trucks and he says the major portion of his tire business is developing into a truck tire business.

Truck Outlook Fails to Justify Gloom

Fenn Says Fall Should Bring Considerable Buying—Normal Trade in Spring

KALAMAZOO, MICH., July 1 — That an unjustifiable feeling of pessimism pervades the motor truck industry is the opinion advanced by F. W. Fenn, secretary of the motor truck committee of the National Automobile Chamber of Commerce.

Fenn was the guest of H. G. Stiles, sales manager of the Kalamazoo Motors Corp., during a short stay in the city. He is making an extended tour of the Middle West and visiting motor truck manufacturers in all localities. Going over the situation and the outlook for the future, Fenn said:

"From information we have been able to secure, there is an unjustifiable feeling of pessimism pervading the truck industry. I look for considerable buying next fall, with a slight slump during the winter months, then normal business from next spring forward.

"My reason for holding that opinion is that business in general is coming back and with the resumption of activities in other manufacturing lines, there is bound to be a demand for trucks."

The Kalamazoo Motors Corp. has been able to operate remarkably well, market conditions for the past year considered. The company has been satisfied to maintain its organizations and accept only such business as could be handled at a profit. H. A. Crawford, president of the company, has adopted a conservative policy in the conduct of the business and has made no effort to greatly increase the company's sales force in face of conditions which made that possible only at great expense.

NEW CHASSIS LUBRICATION

SAN FRANCISCO, July 2 — A new chassis lubricating system by which grease is forced to the bearing surfaces of the chassis under high pressure has been developed by the Lathan Auto Supply Co. The Critz lubricator is made of heavy gage brass. The small diameter barrel used makes high pressures easily obtainable, and by means of the ball check head and the special fittings supplied, it is possible to reach all bearings without the use of flexible connections. The lubricator can be operated with one hand by simply turning the handle to build up pressure in the gun, after slipping the head over the nipple. Where a bearing requires a quantity of grease the head is snapped over the nipple and the latch pulled, the head being locked to the nipple, and the amount of grease required is then forced into the bearing by turning the handle. It is claimed that the lubricator is capable of developing 1500-lb. pressure. In installing the system, the old cups are removed.

Credit Diversion Harming Business

Loans Increasingly Hard to Get Despite Liquidations—Finance Companies Gain

NEW YORK, July 5 — While the Federal Reserve Board and the big banks are asserting that there is an abundance of liquid funds to meet "legitimate" business needs and that credit conditions are easier than they have been in months, business men in some cities declare they are finding it increasingly difficult to get bank loans adequate to handle the volume of orders they are getting.

It unquestionably is true that enormous sums in frozen loans have been thawed out and that money is more plentiful than it has been in the last 18 months, and quoted interest rates have steadily declined, but reports indicate that there has been no material increase in the volume of funds turned into industrial channels. On the other hand, there is an abundance of call money for Wall Street and for other speculative purposes.

Many banks regard loans of this character as more secure than those made for business and industrial purposes, for the reason that they are amply secured by more or less marketable collateral.

While it is vigorously denied that excessive rates are charged for loans of this nature, there is reason to believe that these denials are somewhat technical. When money was scarcest, banks demanded and received bonuses and commissions in addition to high interest rates. It would be difficult to convince a perfectly solvent manufacturer who had been denied a loan by his bank that the surplus funds of that bank were not being sent to New York or some other financial center to be loaned at a greater profit than would be possible in the home town.

Complaints from Up-State

AUTOMOTIVE INDUSTRIES recently received complaints from upstate cities in New York that reputable concerns were experiencing great difficulty in getting bank loans. The subject was taken up with Governor Harding of the Federal Reserve Board. He said that no other complaints of a similar nature had been received and pointed out the low interest rates quoted here. He called the question to the attention of Governor Strong of the New York Federal Reserve Bank, however. Strong stated that it would be impossible to inquire into the complaints without the names of the banks involved and other data which it would be difficult to obtain.

It is somewhat significant that automobile financing companies report that they recently have had more calls for loans than they previously had received for months. This may be accounted for in part by a larger volume of sales, but the finance companies are inclined to believe it represents increasing difficulty in getting bank loans.

Banks have devoted much of their attention for the last year to the liquidation of frozen credits. This process has been successful and they have recovered from industrial enterprises enormous sums which they had invested when the slump came. Bankers in the agricultural sections have been less successful. In some cases business men and manufacturers to whom banks had made loans were carried along until the loans were liquidated in large measure, after which the interest of the banks in these enterprises rapidly dwindled.

It has been contended by the banks ever since the readjustment period began that it would be marked by a survival of the fittest with a gradual weeding out of those weakest financially. There is reason to believe that the "big fellows" will be given stronger banking support than the smaller ones.

Iowa Investigation Shows Business Better

DES MOINES, July 1 — After four days survey of business conditions in southeastern Iowa, H. J. Lytle and A. J. Knapp, president and secretary, respectively, of the Iowa Motor Trades Bureau, report that the past month has seen a decided improvement in conditions among the motor car dealers of that section of the State. The two bureau officials held dealer meetings in Centerville, Albia, Ottumwa, Fairfield and Burlington, and spend their days in interviewing individual dealers.

Dealers in all of the above towns report that there has been a decided upturn, only a part of which is attributed to price cuts. In the main, however, the improvement has not extended to sales among farmers as the farmer has not as yet returned to the market. During the past month, however, prices of grain have shown an appreciable gain and it is thought that if this continues it will result favorably for farmer sales.

The optimistic dealer reports tally with the personal experiences of Lytle, whose firm, the Burlington-Overland Co., is a large distributor in that section of the State. Up to June 25 the business of the Burlington-Overland Co. has surpassed any June business during the past five years.

NORTHWEST CONDITIONS GOOD

SAN FRANCISCO, July 1—The condition of the automotive industry in the Pacific Northwest, throughout Oregon and Washington, is better than has been reported, and is showing continuous signs of improvement, according to W. D. Patterson, head of Patterson Parts, Inc., of this city, who has just returned from a trip through those States. Patterson said:

"Jahns and I found the automobile trade in Washington and Oregon in fairly good shape. It is true that conditions are not all that could be desired, but those concerns selling dependable merchandise are doing a fair volume of business, with a steady, though small, degree of improvement."

Industry Prospering on New Price Basis

N. A. C. C. Reports Mid-Year Changes Bringing Increased Sales to All Companies

NEW YORK, July 1—Price readjustment in the automobile industry seems to have been about completed, judging from the final report just issued by the National Automobile Chamber of Commerce, which shows changed prices on the various makes of cars. The new prices in many instances go back to the figures of a few years ago, notwithstanding that the models, in many cases, are bigger, with better finish and such additional equipment as cord tires and improved electrical apparatus.

In the opinion of students of the industry, the mid-year change has now stabilized the industry to a degree that is bringing increased sales to all companies. Carload shipments from the factories during April and May were 67 per cent of the production for the same two months of last year, and there is reason to believe June will be at approximately the same rate.

Compared with the feverish rush of motor cars last spring a two-thirds demand looks to be a big falling off, but compared with normal years it shows that the motor car business is faring much better than other lines.

Good buying power has been shown where prices have been reduced or where it was known that present prices and quality would be maintained. The National Automobile Chamber of Commerce figures show that with more than 8,000,000 passenger cars in use, the replacement demand alone should be about 1,000,000 cars. The production of passenger cars last year was 1,883,000.

While this week may bring a few more changes in cars that have not been reduced this year, it is generally agreed that the mid-year reductions have stabilized conditions in the industry with little possibility of further changes during 1921.

Better Cars at Lower Price

The success of the automobile industry has been based on big production and the resulting low prices which insure a broad market. For that reason every effort has been made to produce better cars at lower prices to insure the big productions which make increased values possible. Moreover, in these readjustments of the past few weeks, motor car manufacturers generally have taken into consideration the need for increased car and truck sales by the 35,000 dealers throughout the country.

The truck business continues to be on a par with general business, but with an improved future just as soon as general construction and road building programs get under way and railroads perfect their plans for the use of motor trucks for short haul traffic and in connection with store-door delivery.

Few Attend Auction of Overseas Trucks

Conditions in the Transportation Field Blamed for Light Bidding and Sales

NEW YORK, July 5—Lack of interest was the most striking feature of the three-day auction sale here of reconditioned American-made army trucks brought back from England by the Truck Co. of America. There was light bidding because of the small attendance, which did not exceed 50 the last day. Only 90 of the 200 trucks offered were put on sale.

General business conditions in the truck transportation field were blamed for the lack of demand. During normal times there would have been little hesitancy on the part of buyers. One man in attendance stated that while he considered the trucks good purchases, he could not afford to add to his fleet when many of his vehicles were already idle.

Though the vehicles were in good condition and considered bargains, those wishing to buy were reluctant to bid much above $1,500 for any of the trucks. The sale included 5½-ton Macks, 5-ton Pierce-Arrows, 3½-ton Packards, 3-ton Whites, 4-ton Rikers and 1½-ton Commerce.

Because of the light bidding, the auctioneer was forced many times to reject the bids. The last day $900 was the highest bid for one of the Packards. While some of the trucks were said to have been sold for around $2,500, the bidding was carried above the $1,500 mark by representatives of the company.

In one particular instance, the auctioneer led the prospective buyers to believe that the trucks carried a manufacturer's guarantee. This was not so, the only guarantee being one against defective parts within 30 days of purchase.

It is stated that the Truck Co. of America is planning to auction off reconditioned passenger cars used in Europe during the war. No date has been set for this sale.

Alena Steam Products to Make Engine Only

INDIANAPOLIS, July 2—Plans for the manufacture of a steam-propelled truck and tractor have been definitely abandoned by the Alena Steam Products Co., which will devote itself entirely to the production of power units. The Hamilton engine, designed by Fred Hamilton, president and chief engineer of the company, is said to have less than 50 moving parts. It is a double cylinder type, with 4½ by 5½ in. cylinders, radial valve gear and piston valves, and develops up to 110 hp. One feature is that the engine takes care of condensation without the use of cylinder drain cocks. Exhaust steam is carried directly from the cylinders to a tubular condenser mounted in the position of the conventional radiator. Gravity carries the condensed water back to the tank. Pumps supply the boiler.

A feature of the boiler construction is claimed to be that it is impossible to burn the crown sheet. A "mud-ring" at the base of the boiler provides a "self cleaning" feature, and it is said that a clean crown sheet cannot be burned. In addition, the boiler is said to be designed so as to entirely eliminate pitting of flues and to do away with the need for frequent cleaning of flues.

An enlarged type of Bunsen burner, using kerosene, is used. A super-heating device permits of carrying the steam to a temperature of 650 deg. An experimental 5-ton truck has been getting five miles to the gallon of kerosene and 75 miles on 50 gallons of water, according to the officials of the company.

When installed in a truck, the engine crankshaft is connected directly to the differential, and the whole assembly from the rear resembles the conventional rear system of a gasoline truck. The boiler is carried under the hood, which is of the conventional style. The water level in the boiler is controlled and maintained automatically, as is the fire.

The company was organized in February, 1920, and is capitalized at $1,000,000. It will build two types of power plant, a horizontal one for trucks and a vertical one for tractors. The officers are Fred Hamilton, president and chief engineer; John W. Cadle, secretary and treasurer; George W. Kilman, vice-president; C. E. Gordon, general sales manager; R. B. Hall, plant superintendent.

Car Registry in Iowa Ahead of 1921 Totals

CEDAR RAPIDS, IOWA, July 2—Linn County automobile registration for the first half of the year has surpassed the 1920 total and dealers estimate that the 1921 figures will be nearly 50 per cent greater than last year. A few days before the half-year ended the total registration was 11,143 cars and trucks as against a total registration in 1920 of 10,054.

This increase is pointed to by dealers as final answer to reports that business is on the decline and that the much heralded revival failed to materialize. Price reductions in the last few weeks brought immediate response from buyers and the easy manner in which automobile paper is being absorbed is taken as indication that the rural midwest sections are far from financially shaken.

ST. LOUIS REGISTRY GAINS

ST. LOUIS, July 5—Enormous increases in the number of motor vehicles owned by St. Louisans is shown in a survey of the State and city licenses issued by the local offices. Traffic congestion has been so apparent for the past few months that it was certain an increasing number of motor vehicles were using the streets.

J. E. Johnston, supervisor of the St. Louis office, reports that 68,700 State licenses have been issued to date.

Britain Registers 853,900 Cars to May

Passenger Cars and Motorcycles Show Largest Gains—Trucks Growth Small

LONDON, June 24 (By Mail)—Failing an exact statement and an official certificate of production corresponding to the yearly returns of the National Automobile Chamber of Commerce the inquirers after British automobile output have to be satisfied with abstract figures collated from various sources and on odd occasions.

Some striking figures are just issued officially by the Ministry of Transport, London, which cover the five months, January to May. They concern the number of automobiles licensed for road use and the sums paid for that privilege by way of the new horsepower tax. The number of automobiles for which licenses were in force on May 31 was approximately 853,900, yielding $42,180,000 in tax.

The most marked increase is in category "motor hackneys," where the annual licenses have increased from 40,500 to 64,000, while the second quarter licenses were 32,500 as compared with 200 in the first quarter.

The "horse power" class, which includes all private cars, shows an addition of 2000 annual licenses, while the quarterly licenses have increased from 14,000 to 36,000. The increase in the number of licenses for trucks is relatively small, from 13500 to 15000, and it is possible that the numbers shown for this class in the previous return were slightly overestimated.

The number of vehicles for which revnue licenses were issued in the year ended March 31, 1920, was: Private cars, 185,700, as compared with 226,000 in 1921; motorcycles, 278,600, as compared with 370,000 in 1921; motor hackneys, 71,400, as compared with 96,500 in 1921.

The rebate of 25 per cent allowed in the case of "horsepower" vehicles whose engines were constructed before Jan. 1, 1913, has been paid in approximately 31,300 cases, the amount refunded being £133,700. This last item indicates the comparative few pre-war autos now in use.

OILING SYSTEM CHANGES HANDS

PHILADELPHIA, July 2—The manufacturing and patent rights to the safety oiling system have been purchased from the Charles Kralicek & Co. of Cleveland by the Safety Oiling System, Inc., which has occupied its new building at 2303 Fairmount Avenue, this city. Preparations have been made to manufacture the device on a larger scale than ever before. The Philadelphia company has recently been reorganized and incorporated with W. H. Simon, former general distributer for the safety oiling system, as president. The device is designed especially for use on Ford engines but can be used on other types also.

Lower Prices Reduce Export Trade Totals

Trade Index Shows Return to 1913 Volume — Congress Studies Wages Abroad

WASHINGTON, July 2 — Speculation has developed of late as to the effect which recent price reduction on automobiles will exercise on foreign trade. There has been unmistakable evidence that the volume of export business in automotive products continues to shrink without signs of abatement. All branches of the Government have manifested unusual concern over trade tendencies, and the legislative branch is giving careful consideration to the possible effects of high tariffs. While there has been a tendency towards improvement in the domestic situation, the foreign prospects are still unsatisfactory, principally because of the unsettled conditions abroad.

The tariff framers, known as the House Committee on Ways and Means, have just received a compilation of wage information showing wages in the automobile industry here and abroad. They intend to use it in designing tariff schedules in Congress and in establishing a protective policy for American workmen and American standards of living. The statistical study of wages in the automobile industry in this country and abroad was based upon wages paid in automobile factories in 1920. While this data was gathered primarily for the lawmakers, it is of far greater importance to American automobile manufacturers contemplating an expansion of their foreign sales.

Secretary of Commerce Hoover has repeatedly warned of the tendency abroad among manufacturers to consolidate for militant export purposes. It is known that our domestic markets could not be easily invaded because of the strength of the American motor car industry. However, the same condition does not apply abroad, where foreign manufacturers, having the advantage of cheap labor and, in many cases, governmental subsidy, may unite to capture foreign automobile markets from American competitors. It is the labor factor that dominates the whole situation.

Wage Scale Much Lower

The official information in the possession of the United States Government shows, for instance, that skilled mechanics working an eight-hour day in automobile factories in Lyons, France, in 1920, received an average of 26-30 francs per day, which is equivalent to $1.80-$2.10 in American currency. Ordinary mechanics, carpenters, etc., received from $1.54-$1.82 per eight-hour day; unskilled laborers working at machines in automobile factories, $1.40-$1.68; bricklayers, masons, $1.40-$1.68; ordinary unskilled laborers $1.12-$1.40; unskilled female laborers at machines, 84c-$1.40 per day; unskilled female sweepers, etc., 78c-$1.12.

In Germany, with statistics taken from the German Industrial Inspector's report, in 1914 and 1919 it was shown that the rates per day for car and motor workers in Stettin, was $1.09 in July 1914; for machinists in December 1919, 44 cents per eight-hour day. These figures, of course, are based upon the exchange which was remarkably low in Germany at the time. Coppersmiths were paid $1.20 per day in July 1914, and 54c in December 1919; lathe operators, $1.18 per day in July 1914, as compared to 43c per eight-hour day in December 1919; tinsmiths, $1.02 in July 1914 and 46c in December 1919; blacksmiths, in July 1914, $1.09 and 50 cents per eight-hour day in December 1919; cartwrights, $1.11 in July 1914, as compared with 45c in December 1919; cabinetmakers, $1.11 in July 1914 and 45c in December 1919; carpenters, $1.11 in July 1914 and 45c in December 1919; saddlers, $1.11 in 1914 and 42c in December 1919; painters and varnishers, $1.07 in July 1914 as compared with 46c in December 1919; drill operators, $1.09 in July 1914, as compared to 41c in December 1919; planers, $1.13 in July 1914, as compared with 43c in December 1919, and apprentices 25c in July, 1914, and 11c in December 1919. All of these figures represent the rate per eight-hour day.

In England brass polishing and nickel plating plants pay platers of brass a weekly rate of $18.25 and the same applied to nickel platers in 1920.

In comparison, the House Ways and Means Committee has statistics from the report of the New York State Industrial Commission, using the average weekly earnings of New York State factory workers in 1914, 1916, 1918 and

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Gasoline Price Cut Helps British Sales

LONDON, June 24 (By Mail)—The recent reduction of 12 cents a gallon for gasoline has had a stimulating effect on the car trade, though it is reflected chiefly in the light-car class and in Fords. The position of the latter make in Britain has been eventful of late. It has been up against severe competition with the Citroen four-seater from France, especially since the price of the Citroen was reduced by $500 and is now $2,000 against the Ford's $1,200.

The fuel consumption of the Citroen, however, is about half that of the Ford and the taxation is less than half. A while back Citroens were selling in Britain at the rate of 1000 a month and could not be supplied fast enough. The demand for Ford cars thereby was affected seriously but Fords have a more than offset advantage in the van and one tonner. The latter model is selling by the thousand, both this and the van having the market practically to themselves.

The activity in the light-car stock quotations continues, but there is a slump in large car stocks.

Goodrich Organizes Foreign Sales Body

International Subsidiary Will Handle Interests in All Countries but Canada

NEW YORK, July 1—B. F. Goodrich Co. has completed the organization of a subsidiary, the International B. F. Goodrich Co., incorporated under the laws of New York, with an authorized capital of $10,000,000, represented by 100,000 shares of $100 par value common stock.

The new company will represent B. F. Goodrich Co. in all foreign countries except Canada. It will take over the parent company's interest in factories (with selling organizations) located in France and Japan, as well as its selling subsidiaries in Great Britain, Italy, Spain, South America, Straits Settlements and Porto Rico, acquiring distributors in all foreign countries. It will handle all the products of the parent company, which include tires for automobiles, trucks, motorcycles and bicycles; rubber footwear, and all sorts of mechanical rubber goods and druggists' sundries, in addition to the products turned out from factories in France and Japan.

The great volume of foreign business which has been worked up by the Goodrich company has made necessary an organization like the International B. F. Goodrich Co., through which will be effected centralization of all these foregoing activities, which will be directed from administrative and operating offices located at Akron.

Officers of the new company are B. G. Work, president; W. C. Arthur, vice-president; F. C. VanCleef, secretary; L. D. Brown, treasurer; H. Hough, controller; F. E. Titus, director of sales, and W. H. Aleen, director of manufactures. The directorate comprises B. G. Work, W. O. Rutherford, H. K. Raymond, L. D. Brown, H. Hough, W. C. Arthur, C. B. Raymond, F. C. VanCleef, and W. C. Gear.

FRENCH REVISE SPEED LAWS

PARIS, June 12 (By Mail)—Abolition of the speed limit is the outstanding feature of the new traffic laws signed by the President of the French Republic last week.

While there is no speed limit for automobiles weighing 3 ton maximum, it has been considered necessary to fix limitations when this weight is exceeded, in order to assure reasonable protection to road surfaces.

The maximum load per centimetre of tire in contact with the road is fixed at 150 kilos. Steel tires are forbidden for all types of automobiles, but a period of five years is allowed to make transformations. Strakes cannot be used on the wheels of any road vehicles. The maximum overall width of vehicles is fixed at 98 in., and wheel hubs must not project.

European Factories Develop Small Cars

Paris Show to Exemplify Drift from High Operating Cost Vehicle

PARIS, June 18 (By Mail)—Average piston displacement will show a considerable drop on the automobiles to be presented to the public at the Paris automobile show, opening Oct. 5. At the present time the average piston displacement of French automobiles is in the neighborhood of 183 cu. in. if considered on the basis of number of types produced. If actual production figures are considered, however, the average piston displacement drops to about 130 in., for the cars built in the greatest quantities are those with small engines.

The coming drop in size is due to the decision of several important firms having hitherto built only large and medium size cars to put smaller models on the market. This move has been rendered necessary by the changing economic conditions and the desire of the public to possess cars which will be less costly to maintain. It does not imply a reduction in quality, but the building of cars which will be economical to operate because of their low gasoline consumption, smaller tire costs, and reduced taxation.

There is a feeling even among users who have the means to operate a big car that it is economical to maintain two machines—the big one being used for long distance travel when a full load is carried, and the small car getting general and about-town service. The economies in gasoline and tires more than compensate for the taxes on two cars.

Among those who are stepping into the small car field is Delage with a four-cylinder, 10 hp. model fitted with front wheel brakes. When he entered the automobile business, Delage specialized on a car of this size, but during the war he transferred to a big six-cylinder luxury type. This model is being continued, but the new model will be a four-cylinder type of 2.7 in. bore. Delage has no intention of invading the cheap, big production field, but is presenting his smaller type for those clients who feel that it is uneconomical to use a 40 hp. six-cylinder model for town service and short distance trips.

Darracq to Make New Line

Darracq, whose present models are an eight-cylinder of 2.9 in. bore and a four-cylinder of 3.3 in. bore, will probably drop the latter next year when they put on the market a new 10 hp. four-cylinder type. The line will thus consist of a powerful luxury type car and an economical 10 hp. four-passenger automobile. A similar change is contemplated by Lancia, one of the most reputable makers on the Italian market, who will maintain his present big four and supplement it with a popular high grade four.

Sunbeam, in England, has a 10 hp. four-cylinder car under construction, and the Austin factory is also preparing an automobile of the same size and power. Panhard, whose smallest model at present has a four-cylinder engine of 2.8 in. bore, is contemplating the production of a still smaller type. The three biggest producers on the Continent of Europe—Fiat, Renault and Citroen—will not make any important change, for these firms already build cars with the smallest engine possible on a full size four-passenger automobile, the piston bores being 2½ in. for Fiat, 2.9 in. for Renault, and 2½ in. for Citroen.

Voisin to Be Only "12"

With the exception of Voisin, who has a big 12-cylinder high grade car under test, there are no indications that new luxury models will be presented at the Paris show. Even if the 12-cylinder Voisin is offered for sale it will not interfere with the output of the present four-cylinder, sleeve valve engine of 3.7 in. bore.

Two or three of the leading French makers are experimenting with cycle cars, but it is too early to state whether these will be placed on the market next year or not. French conditions call for a machine which will be economical, and which at the same time can maintain a high average over fast and rather rough roads. It is recognized that the problem of producing a two-passenger machine with an engine of not more than 67 cu. in., weighing 770 lb. complete, is not an easy one, and there is a certain amount of hesitation in placing on the market anything which is not mechanically satisfactory.

Up to the present the cycle car has remained in the hands of a limited group of very small firms who do not possess the means to produce in quantities. Experiments are now being carried out by several of the big producers.

California Rail Board Opens Car Department

SACRAMENTO, CAL., July 1—The California State Railroad Commission announces the establishment of an automobile department, due to the great growth of freight and passenger transportation by automotive vehicles in this State. The department will be under the direction of Charles A. Bock, and headquarters will be in the offices of the railroad commission. According to the announcement, the new department will be responsible for all detail work connected with the automobile stage and truck industries in California; will care for all informal as well as official correspondence, complaints and suggestions; will maintain up-to-date timetables and schedules of all automotive services in the State; will handle applications which can be disposed of by ex-parte orders; handle and assign public hearings, answer all verbal inquiries, and in general, assume responsibility to the State Railroad Commission for all work in connection with the operation of motor stages and trucks.

American Cars Open Route Across Andes

First Trip Between Argentine and Chilean Capitals Is Successfully Negotiated

NEW YORK, July 1—The long awaited completion of a transcontinental automobile trip across South America, from Argentina to Chile, has at last been realized. Under the auspices of newspapers of Buenos Aires, the capital of Argentina, and of Santiago, the capital of Chile, with the Automovil Club Argentino, likewise of Buenos Aires, two American cars recently completed the long trip between the two countries, and the Argentine club sees in the result a great boost to road improvement and to touring generally.

Information received by *El Automovil Americano*, the Spanish automotive publication of the Class Journal Co., shows that the two cars were forced to go far south to find a crossing over the Andes. The actual start of the trip to Santiago was made from Bahia Blanca, Argentina, some 700 kilometers south of Buenos Aires. From Bahia Blanca, the cars proceeded westward, crossing the Andes to the south of Chillan, proceeding from there to Santiago by way of Talca. Twelve days were required to make the trip, and the only really serious difficulty was found in crossing the mountains. One of the cars was threatened with being upset when ascending a steep mountain grade, but by quick action the driver was able to prevent serious damage, and the car continued its run without loss of time.

The pathfinders were welcomed by crowds at every city and a reception was tendered them by President Allesandri of Chile at Santiago. For the return trip, which was to be made to Buenos Aires, the route picked to Bahia Blanca and then northward to the Argentine capital, was 2630 kilometers (about 1600 miles).

"The first trial run has brought the matter of road construction and improvement to the attention of all leading persons in both countries," the Argentine club comments. "It will help more than anything else to promote highway building and will be a big influence in fostering the idea of long distance touring in this country."

TRACTORS DO ALL WORK

INDIANAPOLIS, July 1—Tractor men in Indianapolis are interested in a test field of corn just south of the city. The owner of the field is attempting to cultivate the entire crop with motive power. Tractors were used to break the ground to prepare the soil for planting, and for cultivation up to the present time. Yesterday, with the corn three feet high, a tractor was used to draw the twelve-shovel two-row cultivator. The corn sprang up behind the power machinery unharmed, demonstrating the practicality of tractors for this work.

High Tariffs Hurt Exports to Spain

Splendid Opportunities for American Makers Seen With Revision on Equitable Basis

WASHINGTON, July 2 — The American automobile industry in Spain has been almost killed by high tariff duties. Commercial Attache Charles H. Cunningham, stationed at Madrid, reports that at the present time it is necessary to pay a duty of approximately 14 pesetas per kilo on automobiles and motorcycles. This includes 45 per cent surtax for gold.

During the past 18 months the Spanish market has been rather well supplied with second-hand automobiles, both touring cars and trucks, which were left over from the supplies in France. It is reported that aside from these 5000 used automobile trucks have come from Germany and Belgium, though this figure is questioned considerably. In any event, the automobile imports into Spain are quite badly paralyzed by the heavy import duties which were imposed on Dec. 1, 1920. Practically no orders are being placed except for spare parts and a large number of cancellations have been made.

The tariff and exchange situation also has given the French a great advantage in the automobile tire market in Spain, which had been more or less in the control of American manufacturers. The American market also has been greatly harmed, according to Cunningham, by the vast number of irresponsible tire concerns which have sent their products into Spain during the last four years, Some have sold their tires in job lots. Some have sent tires originally destined for use in France. A large number have placed agencies with small concerns doing a business of 40 or 50 tires a month. These concerns cannot sell as cheaply as the larger ones, are unable to guarantee their goods and American tire companies which are being represented by them frequently have to bear the brunt of having their reputations sullied by the practice of their agents.

Recommend Combination

The commercial attache recommends combination as a remedy, through some sort of consolidation similar to the United States Steel Consolidated Corp. under the Webb-Pomerene act, which would maintain an American in Spain to supervise the sale of the products and keep a watchful eye over distribution and at the same time support and stimulate their selling desire. Complaint also is made that American makers of automobiles and tires do not grant as liberal sales commissions as do the French and Germans.

Discussing in detail the situation as it relates to automobiles, it is pointed out that, although supposedly the tariff duties would weigh with equal burden upon all importers, as a matter of fact this is not true. The Ford plant in Cadiz, which was putting together 700 cars a month and employing 200 men, has closed down. It is impossible to sell the more expensive cars of the Packard type for less than 65,000 pesetas, while the Hispano-Suiza and the Fiat of the same reputation and caliber can be sold at 45,000 pesetas, including the body.

The duty paid on automobiles of the Cadillac and Packard types has been increased from 2000 to about 10,000 pesetas, rendering the sales of such cars almost impossible. It is not possible that the Spanish industry will be able for a long time to meet this market's requirements. Accordingly, the new tariff is a protection against American automobiles, the sales of which necessitated the employment of hundreds of people throughout the country, who are now finding their business ruined unless active steps are taken to remedy the situation.

Importers Make Protest

Protests have been made by a number of automobile importers and associations of importers, and it is the common belief that the Spanish government is aware that the Spanish industry is not sufficient to supply the home demand and that the new tariff will bring about a reduction in the duties as established last December.

The general policy of automobile dealers in Spain at the present time with respect to new business is one of watchful waiting. However, in the meantime, it is explained, a typical American industry excelling that of other countries is entirely paralyzed, and should this condition continue there will be considerable financial distress among friends of American manufacturers and the former will be forced to turn to the representations of German and French cars against their will.

The only plant in Spain that seems to be doing a purely Spanish automobile manufacturing business is the Hispano-Suiza of Barcelona and Guadalajara. It is stated that the total capital invested in this enterprise is about 50,000,000 pesetas. During the war the Hispano-Suiza Co. sacrificed its automobile production for the making of airplane engines, 75 per cent of which were sold to the allies. There is said to be at present about 1600 men at work in these plants. They earn all the way from 8 to 15 pesetas a day in wages. A large part of the specialized machinery utilized came from the United States and England and the American machinery is said to have given entire satisfaction. At the present time Hispano-Suiza is engaged in work on 12 different types of car chassis and engines.

All Work Done at Plant

It is stated that all of the work on all of the parts except the wheels for the touring car is done in the Hispano-Suiza plant. Truck wheels are also made and the wire wheels utilized on the touring car and passenger car chassis are of the Rudge-Whitworth type made in England. The output of the Hispano-Suiza plant

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Dealers to Outline Contractual Views

N. A. C. C. and N. A. D. A. Conferees Approach Basis for New Business Relations

DETROIT, July 2—Efforts looking to the establishment of close co-operation between factory executives and dealers are beginning to breed results. Committees representing the National Automobile Chamber of Commerce and the National Automobile Dealers' Association expressed themselves highly pleased with the results of their second conference held at the Detroit Athletic Club yesterday. The conference was continued to July 12, when the committees will meet in Buffalo.

A formal draft of the position of dealers on matters under discussion will be presented at the Buffalo meeting by Harry G. Moock, general manager of the dealers' association. Following yesterday's meeting he expressed confidence that action favorable to the industry generally would be taken at that time.

Developments at yesterday's meeting were practical agreements to the effect that cancellations of contract in the future shall be only on recognized factory authority rather than at the hands of various persons as now is possible. That persons suffering cancellations should have opportunity for appeal also seemed to carry weight with many of the conferees. There also seemed to be unanimity of opinion that contracts should be made dependent on performance rather than subject to renewal at definite dates.

The question of the disposition of cars in cases of contract cancellation brought forth considerable discussion but no definite action was indicated.

General Manager Alfred Reeves of the N. A. C. C. expressed gratification after the meeting at the harmony which characterized the proceedings and said it gave assurance that all problems now being threshed out would be settled.

Reports on N.I.V.A. Contest at Fargo Available July 11

FARGO, N. D., July 5—The National Demonstration and Show Committee of the N. I. V. A. has issued the following statement in regard to the tractor and horse contest staged here.

"Data secured in connection with the Fargo Farming Demonstration will not be complete until the horse outfits have finished their work and the records of all tractors and horses have been carefully checked. No information on this subject will be given out until July 11, on which date the National Committee will meet again in Chicago.

"Results of the Fargo Demonstration will be discussed at that time with a view to deciding future demonstrations. Information and the data regarding the Fargo demonstration will be made public."

Babson Would Keep Executives on Job

Says Market Speculation Hurts Car Development—Predicts Coal Dust as New Fuel

TOLEDO, July 6 — Roger Babson, economist, who visited Toledo to make several addresses to business men and to study the automobile industry here, declared his studies had led him to the belief that the best showing is going to be made in the automobile industry by the companies which absolutely bar the officers and employees from automobile and other stock market speculations.

"Automobile officials have paid too much attention to the stock market and not enough heed to the quality of the cars they were turning out," he declared.

Babson said the swing in automotive channels was toward not only the use of light models but the manufacture and use of lighter machines than are now being driven.

He pointed to two lines of experiment that were fundamental to the automotive industry, in his opinion. One was the use of bituminous coal dust for fuel and the other was the development of cottonoid and paperoid bodies for lighter construction.

"I happen to be conversant with experiments now being made by several automobile manufacturers in the use of bituminous coal dust as fuel for automobiles instead of gasoline," said Babson, "and the result of the experiments so far indicates that within a few years gasoline at high prices will no longer be used as motive power for automobiles.

"The coal dust will be blown into the carburetor of the car and burn with sufficient intensity to provide all the heat and power necessary for the operation of the machine. Fifty cents' worth of coal dust thus utilized will carry a car the same distance that five dollars' worth of gasoline now carries it. This decrease in the cost of operating an automobile will greatly increase the use of automobiles.

Plan Lighter Automobiles

"I have witnessed experiments with cars whose bodies are made out of a combination of formaldehyde, glue and cotton, a material that has come to be known as cottonoid. Similar material may be made out of paper as one of the three ingredients, so to speak, instead of cotton. So we are to have automobiles with cottonoid or paperoid bodies, making the car much lighter, and more durable and cheaper.

"I saw an experiment made with a car that had a cottonoid fender. The car was made to collide head on with a brick wall. The cottonoid fender gave in like rubber and rebounded the car like a rubber ball. Such a fender does not break or bend like steel, but has resiliency and sufficient strength to protect the machine in collision.

"It is not the initial cost of a car that keeps down the sales of automobiles, but the upkeep. With lighter bodies made of the new material and with better tires—and they are coming, too—the increase in the sales and the use of automobiles will be enormous, for the initial price will be lower and the upkeep much less expensive."

Babson believes that the present center of manufacture of motor cars is best adapted to their production and that the territory in the vicinity of Detroit, Cleveland and Toledo will continue to be the great automotive district.

Willys Takes Message of Cheer to Dealers

PHILADELPHIA, July 2—John N. Willys, president of the Willys-Overland Co., introduced by Harry B. Harper, president of the Overland Harper Co., addressed a meeting of Overland Harper dealers at the headquarters of the local company, Forty-second and Chestnut streets, bringing a message of optimism to the trade.

Among the things Mr. Willys said were:

"Work is a great thing. It will accomplish anything. We have weathered the storm and now it is plain sailing ahead. We are back to the production of 400 cars a day and by next month we expect to increase this to 600 cars. Our organization is the best we ever had, and so are the shopmen."

"June was good," said H. B. Harper, "but it isn't going to be a patch on what we are going to do in July. Our product is right, our prices are right, and this response of the buying public proves that better business, increased sales and a big future await us."

Rush of Truck Sales Reported in South

BIRMINGHAM, ALA., July 6—With the renewal of activity in the lumber business and all other building material businesses in Birmingham, the sales of trucks have shown a marked increase, according to local automobile dealers.

The demand for new trucks has increased during the month of June so rapidly that all orders placed by local building material dealers could not be filed on schedule time. Many of the most urgent buyers were compelled to wait for delayed shipments to get their new equipment.

"Receipts on repairs at the garage would indicate that the number of cars is increasing," said P. Y. Whitman, of Whitman's Fifth Avenue Garage.

"Buicks are selling faster than we can order them in," sad Donald Drennen of the Birmingham Motors Co.

"Dealers who are members of our organization are very optimistic over the outlook for the coming year in the automobile business," said James P. Dobbins, secretary of the Birmingham Automobile Club. "They are anticipating a banner sales year for new cars. Business was light for a time, but the automobile line is picking up now."

Denby Creditors Plan Funding Firm's Debt

Committee Is Named to Work Out Refinancing—Truck Prices Reduced

DETROIT, July 2.—Creditors of the Denby Motor Truck Co., at a meeting yesterday, named a special committee of five, headed by J. H. Johnson, president of the Peninsular State Bank, to formulate plans for presentation July 12 for funding the company's indebtedness. C. A. Ailes, a member of the creditors' committee which has been operating the plant for the last year, said that while the plant is free of all bonded indebtedness the plan in view is to ask creditors to accept part payment in bonds and the balance in stock in order that the company's statement may be put on a bankable basis. It also is proposed to issue bonds for about $100,000 as class A bonds to furnish working capital.

In addition to Johnson, the committee is composed of J. M. Burns and B. J. Lincoln, Detroit attorneys representing creditors, O. W. Myers, district credit manager of the Goodyear Tire & Rubber Co. and W. P. Fuller of Fuller & Sons Co., Kalamazoo. The Denby company will continue in operation. It has debts of about $650,000 but is solvent and assured of success if given opportunity to work out of its present difficulty, said Ailes.

Announcement was made by the Denby company today of price reductions effective immediately. The three-quarter-ton and 1-ton speedster will sell for $1,625; the 1½-ton for $2,300; the 2-ton for $2,600; the 3-ton for $3,300; the 4-ton for $4,200; the 5-ton for $4,850, and the 7-ton for $5,500. This is a reduction of $200 on the 2-ton, $300 on the 3-ton, $400 on the 4-ton, $500 on the 5-ton and $700 on the 7-ton.

The light trucks are equipped with pneumatic tires and the others with solids. All models except the speedster are equipped with bumpers.

Federal Trade Board Accuses Rubber Firm

WASHINGTON, July 5—Issuance of a complaint against the Diamond Holfast Rubber Co. of Atlanta, Ga., has been announced by the Federal Trade Commission on allegation of unfair competition in the manufacture and sale of automobile accessories and repair materials in interstate commerce. It is claimed that this company marketed its products in such a way as to pass them off as the products of the Diamond Rubber Co., a subsidiary of the Goodrich. It is further alleged that the respondent sold its products in containers with labels which featured the word "Diamond" and so closely resembled the labels of the Diamond Rubber Co. The company has 30 days to file an answer.

122 Inch Engines for 1923 Classic

Indianapolis Fixes Lower Displacement

Limitations Below Specifications of Any Car Now in Quantity Production Here

INDIANAPOLIS, July 7—T. E. Myers, secretary and manager of the Indianapolis Motor Speedway Co., has announced that the 1923 race on the famous track will be for cars powered with engines having a maximum piston displacement of 122 cu. in. Translated into European terms this is two litres. The 1922 500-mile race, the tenth annual event, will be for three litre cars, or engines of 183 cu. in., the same size as the 1920 and 1921 races.

This is the fifth time that the Indianapolis track has reduced the engine sizes for the cars competing in the five-century, considered by some the classic of all the world's annual speed events. Offhand such reductions would be expected to result in decreasing the speed of the cars, but such has not proven to be the case. Automotive engineers have thus far been able to obtain more speed in fact by designing smaller bore and higher speed engines.

The 1923 race will have engines smaller than anything now built in quantity in America. The smallest engined car to-day in large production is a four cylinder, measuring 143.1. The Ford engine is near the 183 maximum. Reductions in the size of racing engines have frequently been reflected later in the stock production of the American makers. The "crucible of racing" has proved to the satisfaction of the engineers that fuel economy could be effected by reducing the engine sizes. In the last race the average car's mileage was ten to the gallon. Two years hence it should pass the twelve mile mark.

The efficiency of the two litre engine was demonstrated recently in the French economy Grand Prix at LeMans, where a De Dion Bouton of this class showed 49.09 miles to the gallon in a stock test.

Except for the announcement of the engine limitations no other specifications for cars admitted to the race have yet been made public.

Overland Goes Over Expected June Output

TOLEDO, July 5—With a big drive through to the last day of June, the Willys-Overland plant here went 37 cars over its schedule for the month for a total production of 8537 cars for the month. On June 2 the schedule was fixed at 3500, but the increased volume of sales caused this to be boosted to 8500 for the month. Purchasing agents, production men and others struggled through the hot weather to "come through," and the record was made.

The July production will be increased 50 per cent and, according to appearances, August will be a busy month at the plant. Some departments at the factory here have been forced to put on three eight-hour shifts this month. The big month was the first real test of the new production system put into effect by Vice-Presidents Walter Chrysler and Charles B. Wilson.

Reo Motors Down for Two Weeks' Vacation

LANSING, MICH., July 2—All departments of the Reo Motor Car Co. except the service and repair closed to-day for two weeks. The simultaneous vacation plan has been under consideration for some time. Opposition to the plan was overcome by the argument that present business conditions made the opportunity for trying it out most propitious. H. C. Teel, general superintendent and an ardent advocate of the plan, said it was the intention to drop all work wherever possible even in the repair and service departments and take two weeks rest in the hope of eradicating all feeling of apprehension regarding market conditions.

Dodge Orders Assure Production to 1922

DETROIT, July 2—The announcement was made to-day by Dodge Bros. through President Haynes that production would be maintained at capacity for the remainder of the year. Production at the Dodge plant since the price cut has been increasing daily and is now around the 600 mark. That output, Haynes said, would be continued throughout the year. This assertion is based on present orders and prospective demands.

Haynes said dealers' stocks were exhausted and that cars rapidly are going into the hands of consumers. The factory is far behind on orders.

TO PICK A. A. A. SECRETARY

NEW YORK, July 6—The Executive Committee of the American Automobile Association at a regular meeting at the Hotel Commodore to-day named a committee of three—George Diehl, president; David Jamison, past president, and Horace Bonnell, treasurer—giving it authority to appoint a successor to A. G. Batchelder, the late executive secretary who was killed in an airplane accident near Langley Field. The committee will announce its selection soon.

Franklin Sets Marks on 20th Anniversary

Ships 138 Cars in Day and Completes Biggest June in History

SYRACUSE, July 2—Three leading events in the history of the Franklin Automobile Co. were celebrated this week—two of them records for shipments and sales, established on the same day, June 30, and the third, the twentieth anniversary of the company, July 1.

The Franklin company shipped 138 cars Thursday, the biggest shipment for one day it ever made. The last previous record was made on Dec. 31, when 110 cars were shipped.

On the same day Franklin dealers throughout the country sold 132 cars, which establishes a record, and helped make the company's business for the month the largest for June in its history. Last year was considered a banner year for car orders, but four more cars were shipped last month than in June, 1920, the total being 1031.

In celebration of the anniversary the company officials and employees held a parade, headed by the Franklin band of 35 pieces. A feature of the procession was the first Franklin car ever sold, run on its own power. In this car rode a man and woman dressed in the styles of twenty years ago. John Wilkinson, who built the car, rode just behind it in a 1921 Franklin sedan.

In 1901 Wilkinson, who is now vice-president and consulting engineer of the Franklin company, started work for H. H. Franklin and A. D. Brown, now of the Brown-Lipe-Chapin Co., under the name of Brown & Franklin Co. The first car was turned out March 3 of the following year. This car had four elliptic springs, a wood frame instead of steel, and an air-cooled engine, features which have endured in Franklin cars right through to the 1921 models.

Thirteen cars were turned out in 1902, of which eleven were sold. Sixty-five persons were employed the first year, and in the twenty years since then the force of employees has grown to 3200.

Car Reductions Swell Chicago Sales Totals

CHICAGO, July 6—In all lines of cars which have reduced prices there was a very decided improvement in sales for the month of June as compared with May and April. In many cases reports are to the effect that record sales are the result of June efforts. Automobile Row in Chicago appears to be busier than in months.

FINANCIAL NOTES

International Motor Truck Co. reports sales to June in excess of 2400. This is at the rate of 70 per cent of last year's business. Net quick current assets are in excess of $20,000,000. Cash is over $3,500,000, while notes and accounts receivable are in excess of $5,000,000. Inventories have been reduced more than $3,000,000 since January and will be reduced still more during the next three months. Commitments for material are very slight and only for current requirements.

Timken-Detroit Axle Co. reports sales running at approximately $1,200,000 a month. Normal business is about $35,000,000 annually. Since January 1 inventories have been reduced from $10,900,000 to about $9,500,000. Bank loans were cut from $3,000,000 to $1,200,000, but $1,000,000 one year notes were sold.

Kelly-Springfield Tire Co. will pay quarterly dividend of $2 a share on its 8 per cent preferred stock August 15. A quarterly stock dividend of 3 per cent will be paid on the common stock of the company, in common stock, on August 1.

McCord Mfg. Co., Inc., reports an increase in its cash balance to well over $500,000, as against $100,000 in February, 1921. It was said the company had sold a large amount of radiators into which it had put copper costing 24 cents a pound.

Maibohm Motors Co. has been granted a judgment of $14,000 against the Sandusky Chamber of Commerce as the 1921 installment of $100,000, the Chamber agreed to pay provided the company moved its plant to Sandusky.

Handley-Knight Co. has had approved by the Michigan Securities Commission its $200,000 issue of first mortgage 7 per cent convertible gold bonds. They are dated April 1, 1921, and run fifteen years.

Studebaker Corp., with a total production in June over 8000, will give the company the biggest quarter by far it has ever had. Studebaker should top 25,000 cars in the third quarter if present conditions continue.

American Motor Body Co. reports net profits of $269,457, after interest and Federal taxes, for the period from August 11 to December 31, 1920. Sales during this time amounted to $8,523,875.

Federal Motor Truck Co. paid a dividend of one-half per cent (5c.) on July 1. The last previous payment was 1 per cent on January 1, 1921.

INDUSTRIAL NOTES

American Forging & Socket Co., Pontiac, Mich., reports that after several months of idleness, in which the plant was almost wholly inoperative, it is now going strong and experiencing a steadily increasing demand for products. At present operations are about 60 per cent of normal.

C. G. Spring Co., Kalamazoo, Mich., is now working 75 per cent of capacity to keep up on orders for automobile bumpers. Several large contracts have recently been taken on, while the replacement business is growing rapidly.

H. L. Hess Co., Philadelphia, has been appointed representatives for the Mueller Metals Co. of Port Huron, Mich., in Eastern Pennsylvania, Delaware, Maryland and Southern New Jersey.

Alvord Reamer & Tool Co. of Millersburg, Pa., now has branches in the following cities: New York, Philadelphia, Pittsburgh, Cleveland, Detroit, Chicago, Louisville and San Francisco.

Cleveland Tractor Co., Cleveland, has moved its Atlanta office to larger and more pretentious quarters at 254 Peachtree Street. S. A. McGonigal is in charge.

Winton Co. is operating at 30 per cent capacity and orders are gaining, President Winton reports.

Goodyear Tire & Rubber Co. will increase production to 3500 tires a day at the Los Angeles plant.

Greenfield Tap & Dye Corp. four plants at Greenfield, Mass., will be closed until August 1.

New Plea to Creditors Made By Oklahoma Firm

MUSKOGEE, OKLA., July 5—The Oklahoma Automobile Manufacturing Co., which asked unsecured creditors early in the year to accept 25 per cent of their claims in full payment, now has notified creditors that it is unable to make good on this offer, but that it is in a position to pay 20 per cent. It is said that by the hardest kind of work the management has raised about $88,000, but is unable "to raise another dollar." This is sufficient to pay only 20 cents on the dollar. The letter says the receiver is selling no trucks whatever and is unable to collect installment notes taken in payment for trucks. Collections are so small that they are not sufficient to continue operations even on a very small scale. Creditors are informed that if they fail to accept the offer made, the company will be thrown into bankruptcy.

Gorrell Takes Over Marmon Sale on Coast

SAN FRANCISCO, July 5 — One of the most important announcements made in the automotive trade of northern California in June was that of an almost complete change in the personnel of the local division of the Al. G. Faulkner Co., Marmon distributors for California, Nevada and the Hawaiian Islands. Colonel E. S. Gorrell, formerly in charge of merchandising for Nordyke & Marmon, Indianapolis, becomes manager of the San Francisco branch, and brings with him W. E. ("Bill") Combes as sales manager. Colonel Gorrell, who is a graduate of West Point, began his service in 1914 as a flier in the aviation section of the Signal Corps and finally became chief of staff, A. E. F. He was awarded the Legion of Honor by France, the D. S. C. by England, and the prized Distinguished Service Medal by the American Government. During the spring of 1920, Colonel Gorrell resigned his commission and turned his attention to sales promotion with the Nordyke & Marmon company. His combination of engineering, merchandising and general business experience won for him the San Francisco post.

BANK CREDITS

Written exclusively for AUTOMOTIVE INDUSTRIES *by the Guaranty Trust Co., second largest bank in America.*

NEW YORK, July 7—While the industrial situation still had a depressed aspect as the half-year closed, the credit situation, as reflected in the bank figures, encouraged the feeling that the basis was being laid for a substantial return to normal conditions. The New York Federal Reserve Bank last week again showed the remarkable improvement which has been characteristic of recent weeks. The ratio of total reserves to deposit and Federal Reserve note liabilities combined increased from 68.9 per cent to 70.7 per cent, the highest since the summer of 1917. The ratio of gold reserves to Federal Reserve notes in circulation, after setting aside 35 per cent against deposit liabilities, increased from 103 per cent to 106.7 per cent. This improvement in the reserve ratio was largely the result of a $23,341,000 increase in gold reserves, which was in turn largely due to further gold imports.

The Federal Reserve System's ratio of total reserves to deposit and Federal Reserve note liabilities combined increased from 60.4 per cent to 60.8 per cent, the highest since 1918. Gold reserves increased $11,443,000 and total reserves $5,453,000. In spite of a decline in bills discounted secured by Government obligations, total discounts increased $17,599,000. Total bills on hand, however, increased only $9,712,000, while total earning assets declined $21,908,000. Total deposits declined $11,459,000, and Federal Reserve notes in circulation $4,844,000.

The local call money market took on a slightly firmer tone the latter part of the week. The range for the week was 5 per cent to 6 per cent, as against 5 per cent to 5½ per cent the previous week. On Monday a uniform rate of 5 per cent was quoted, and the following two days 5½ per cent was the renewal rate; but on Thursday and Friday a uniform rate of 6 per cent was quoted. This firmness was due apparently to preparations made for the middle-of-the-year's settlements and to Government withdrawals. The time money market was unchanged at 6½ per cent for 60 and 90 days' and four months' paper, and 6 per cent to 6½ per cent for five and six months' paper. There was a small supply of loanable funds, and quotations remained nominal. The commercial paper market was unchanged.

Business failures for the month of June showed a decline, the number of failures at 1290 being the lowest for any month since November, and compare with 1356 in May, and 1895 in January. They are, however, far above the 674 failures reported for June, 1920. The liabilities involved were also much smaller than for the previous month, the respective figures being $31,987,313 and $57,066,471. The liabilities were also the smallest for the current year.

NEW CAR PRICES

Packard Cuts Prices on Cars and Trucks

DETROIT, July 5—New prices on Packard single and twin-six models as now effective, place the single-six coupe and sedan at $3,750 and $3,975, reductions respectively from $4,150 and $4,250. In the twin-six the open models are reduced from $6,000 to $4,850 and the coupe and sedan from $8,200 and $8,450 respectively to $6,600 and $6,800. The limousine is reduced from $8,350 to $6,650, and the chassis from $5,300 to $4,200.

On trucks model EC is reduced from $3,700 to $3,500, ED from $4,450 to $4,100, EF from $5,550 to $4,500 and EX from $4,200 to $4,000.

Oldsmobile Revisions Include All Models

NEW YORK, July 1—Price changes announced on the various models of the Oldsmobile, effective July 2, follow:

	Old Price	New Price
Four-cylinder		
Roadster	$1,445	$1,325
Touring	1,445	1,345
Coupé	2,145	1,895
Sedan	2,145	2,100
Light 8-cylinder		
Touring	1,695	1,725
Coupé	2,395	2,225
Sedan	2,395	2,425
Big 8-cylinder		
Touring	2,100	1,825
Touring 7-passenger	2,100	1,875
Sedan	3,300	2,775

90-Day Guarantee Given By Mack Against Cutting

NEW YORK, July 5—The International Motor Truck Corp., manufacturers of Mack trucks, has decided to give a running guarantee of 90 days to both dealers and purchasers against price reductions. No time limit has been set upon the period during which this guarantee will be given, but it can be revoked by the company at any time. All purchasers of trucks in the meantime will be guaranteed except where trade-ins are involved.

CHAMPION MOTORS MAKES CUT

PHILADELPHIA, July 5—The Champion Motors Corp. announces reductions in the prices of its various models. The special touring car is reduced from $1,595 to $1,395; the Champion "tourist" from $1,250 to $1,095, and the commercial car to $1,325.

WOLVERINE TRUCKS CUT

DETROIT, July 1—In conjunction with the announcement of a new line of trucks, the American Commercial Car Co., manufacturers of the Wolverine truck, have reduced prices on the entire line from $50 to $115. The new line will take the place of the former models, and while substantially the same, will embrace new and distinctive features. The new prices are: 1-ton $2,125, formerly $2,240; 1½-ton $2,375, was $2,465; 2-ton $2,640, was $2,750; 2½-ton $3,425, was $3,475, and 3½-ton $4,100, was $4,150.

OAKLAND MAKES SECOND CUT

DETROIT, July 6—Prices on the Oakland roadster and the coupe and sedan were reduced to-day by the Oakland Motor Car Co., the reduction being the second announced by the company since May. The new roadster price is $1,095, a reduction from $1,145. The coupe is priced at $1,625 and the sedan at $1,725, both formerly being $1,815. The touring car, which was placed at $1,145 in the May reduction, remains at that price.

EXCELSIOR CUTS PRICES

CHICAGO, July 2—The Excelsior Motor Mfg. & Supply Co. announces new prices on Henderson and Excelsior motorcycles. The electric equipped Excelsior is reduced from $480 to $400 and the electric equipped 4-cylinder Henderson from $585 to $485.

REDUCE VELIE MODELS

MOLINE, ILL., July 5—New prices are announced on various models made by the Velie Motors Corp. The model 48 touring car is reduced from $1,855 to $1,595; the model 34 touring car from $1,485 to $1,385; the model 48 sedan from $2,885 to $2,485; the model 34 sedan from $2,485 to $2,085, and the model 34 roadster from $1,485 to $1,385.

CLYDESDALE PRICES CUT

CLYDE, OHIO, July 7—Prices on Clydesdale trucks have been reduced on models from 1½-ton to 5-ton. Model 42, 1½-ton, is cut from $2,750 to $2,475; Model 65, 2½-ton, $3,540 to $3,250; Model 65E, 2½-ton, $3,775 to $3,450; 3½-ton, $4,400 to $4,100, and 5-ton, $5,500 to $4,500.

CASE DOWN $400 TO $500

CHICAGO, July 9—Prices on Case Motor cars have been reduced from $400 to $500 on all models. The touring and sport models have been reduced from $2,650 to $2,250, the coupe from $3,400 to $2,900, and the sedan from $3,750 to $3,285.

Goodyear Cotton Mills Resumes Manufacturing

DANIELSON, CONN., July 2—The Goodyear Cotton Mills, Inc., one of the leading industries of this section, engaged in the manufacture of tire fabric, will be reopened Tuesday morning on a one-shift working schedule of 40 hours per week, according to Vice-President P. W. Litchfield this week. The plant was closed 10 months ago and since has not turned a wheel.

On a one-shift 40 hours per week schedule, the plant will be on a basis of about 25 per cent of the production that was being turned out last summer.

MEN OF THE INDUSTRY

E. A. Sattler, until recently director of sales of the Howe Rubber Corp., New Brunswick, N. J., and Theodore Weigele, formerly assistant sales manager of the same company, have taken over the sale of the entire output of the Eckrode Rubber Company, Inc., of Newark, of which Clement E. Eckrode is president. Sattler was elected vice-president of the company at a meeting of its board of directors several days ago. Sattler and Weigele are organizing for national distribution before the year's end.

Harry W. Walters has been named sales manager of the Herring Motor Co., Des Moines, to succeed N. W. Lovegrove, resigned. Mr. Walters has been with the Herring organization for nine or ten years, starting in a minor capacity, and for the past three years has been assistant sales manager. Walters has been elected to the place on the directory board of the Motor Trades Bureau of the Chamber of Commerce, made vacant by Lovegrove's resignation. Mr. Lovegrove has not announced his plans.

Charles B. Shanks, for more than six years manager of Motor World, has become associated with the Anderson Motor Co. of Rock Hill, South Carolina, manufacturers of the Anderson Six. He will appear on the official roster as vice-president of the corporation and will give principal attention to sales, advertising and service. Prior to Shanks' connection with the Class Journal Co. he was for ten years sales and advertising manager of the Winton Motor Car Co. of Cleveland.

George R. Morris has resigned as manager of the Chevrolet New York retail store to join W. C. Sills, former sales manager of Chevrolet, in the distribution of that car in the New England district. Harry Horton who has been manager of the Providence retail store will succeed Morris in the New York managership.

Birger Jacobsson, formerly vice-president of the J. B. Crockett Co., New York, has resigned, and is now in the same kind of business with his own company, of which he is the president, with head offices at Stockholm, Sweden. His address is Birger Jacobsson Company, 11 Karduansmakaregatan, Stockholm.

W. J. Drumpelmann, assistant sales manager of the Hudson and Essex for the last four year's has resigned. He was formerly in the sales department of the Chalmers Motor Co. for three years. He has not announced his future plans.

H. M. Wirth, purchasing agent of the Kelsey Wheel Co., has severed his connection with that organization and is succeeded by Arthur Conklin who for two years was assistant to Wirth and for ten years with the company.

P. L. Emerson, assistant sales manager of Reo, has been transferred to San Francisco where he will take charge of the Reo branch.

RECEIVER ASKED FOR FIRM

KANKAKEE, ILL., July 2—Dissolution and receivership of the Kankakee Automobile Co., and enforcement of directors' and stockholders' liabilities, were asked in the Kankakee, Ill., Circuit Court June 30. The company was alleged to have violated State laws and was never developed beyond the promotion stage.

Calendar

SHOWS

Sept. 5-10—Indianapolis, Automobile and Accessory Show in conjunction with Indiana State Fair, conducted by Indianapolis Automobile Trade Association, John B. Orman, Mgr.

Sept. 28 - Oct. 8 — New York, Electrical Exposition, 71st Regt. Armory, Electric Equipment, Machinery and Vehicles.

Nov. 27-Dec. 3—New York, Automobile Salon, Hotel Commodore.

January — Chicago, Automobile Salon, Hotel Drake.

Jan. 7-13—New York, National Automobile Show, Madison Square Garden, Auspices of N.A.C.C.

Jan. 28-Feb. 2—Chicago, National Automobile Show, Coliseum, Auspices of N.A.C.C.

FOREIGN SHOWS

September—Buenos Aires, Argentina, Passenger Cars and Equipment. La Pabellon de las Rosas. Automovil Club Argentino.

September—Buenos Aires, Argentina, Cars, Trucks, Tractors, Farm Lighting Plants and Power Farming Machinery. Palermo Park; Sociedad Rural Argentina.

September—Luxemburg, Luxemburg, Agricultural Sample Exhibition.

Sept. 23-Oct. 2—Berlin, German National Automobile Show, Auspices of German Automobile Mfg. Ass'n and German Automobile Club.

Oct. 5-16—Paris, France, Paris Motor Show, Grand Palais, Administration de l'Exposition Internationale de l'Automobile, 51, Rue Pergolèse, Paris.

Nov. 4-12 — London, British Motor Show, Society Motor Mfrs. and Traders.

May, 1922—Quito, Ecuador, Agricultural Exposition, celebrating Centenary of Ecuador. Automotive Section.

CONVENTIONS

Oct. 12-14, 1921 — Chicago, Twenty-eighth Annual Convention National Implement & Vehicle A'ssn.

Nov. 22—New York, Convention of Factory Service Managers, National Automobile Chamber of Commerce.

Dec. 27-29—Chicago, American Society of Agricultural Engineers, Auditorium Hotel.

RACES

July 25—Grand Prix, Le Mans.

Labor Day—Uniontown, Pa., Autumn Classic.

Tommy Milton in Durant Wins Tacoma Sweepstakes

TACOMA, July 4—Before a crowd of 30,000 Tommy Milton in a Durant Special won the $25,000 purse in the 250 mile event in the tenth annual racing meet here to-day. He finished the 125 laps in 2:34:15. Roscoe Sarles was second in a Duesenberg Special. The time was 2:34:52. Rene Thomas was third. His time was 2:38:47. Eddie Hearne in a Revere Special finished fourth; Tom Alley, Frontenac Special, fifth; Edward Miller, Duesenberg Special, sixth.

Eddie Pullen and Elliott, the former in a Duesenberg Special and the latter in a Leach Special were flagged from the course at the 100th lap. Elliott was off to a poor start. Soules led the field for the first fifty laps but was forced out in the sixty-first when he burned out pistons. Alley was forced to the pits in the fifty-eighth because of his left rear and again in the eighty-fifth.

Pullen drove a slow race because of pre-ignition troubles. Thomas changed to the rear in the eighty-fifth. Then Hearne followed suit in the eighty-eighth. Alley went to the pits again in the ninety-eighth because of his right rear.

The last twenty-five laps was a battle between Milton and Sarles, Milton passing the Duesenberg in the 105th. Elliott went to the pits in the 119th with left rear trouble. Milton averaged better than 98 miles and broke the record of 1920, adding 500 points to his year's record. Rickenbacker refereed with Harroun driving. A Marmon was pacemaker.

The weather was ideal for racing. Entertainment was provided by massed bands under the direction of the American Legion.

Milwaukee Plants Hold "Model Factory Picnic"

MILWAUKEE, July 2 — A "model factory picnic" was held Saturday, June 25, at Waukesha Beach, Pewaukee Lake, west of Milwaukee, by special co-operative arrangement among the biggest industries of Milwaukee for the edification of nearly 5000 social workers attending the national conference in Milwaukee, June 22 to 29. Each year the industries individually give outings for employees, usually at Waukesha Beach, the largest resort for this purpose in the vicinity.

A. Holmes of the Cutler-Hammer Mfg. Co. functioned as general chairman of the picnic committee. He was assisted by L. H. Fountain of A. O. Smith Corp., A. E. Borgeson of Avery Co., H. C. Best of National Brake & Electric Co., L. G. Meisenheimer of Globe Seamless Steel Tubes Co., E. H. Fitzgerald, Federal Rubber Co., and others.

Commercial Haulers Want Parts Service Stations

MILWAUKEE, July 2 — A resolution condemning the action of manufacturers of assembled trucks in opposing the establishment of parts service stations throughout the country by makers of unit parts was adopted by the National Association of Commercial Haulers at its annual convention which closed here to-day. The organization will do all it can to foster the service station idea.

Joseph X. Galvin, [illegible] ent of the National Team & Truck [illegible]ners' Association, addressed the members and told them he had come to the convention to urge amalgamation of the two associations. A resolution favoring such action was adopted but the actual working out of the details was left to the officers and executive committee.

F. J. Alvin, manager of the United States Motor Truck Co. of New York, which is headed by former Governor Alfred E. Smith, informed the convention that he had come to Milwaukee to pledge the assistance and support of his company to the association.

It was decided to separate the office of manager and secretary, both of which have been held by C. R. Collins of California. Collins will remain as manager while Tom Snyder of Indianapolis, who is secretary of the Indiana Transfermen's Association, will become secretary of the National Association.

One of the resolutions adopted favored passage of the Townsend highway bill.

Sheet Metal Makers Form Group in M.A.M.A.

NEW YORK, July 6—The Sheet Metal Manufacturers' Association decided at a meeting in Detroit last week to dissolve and continue its work as a group of the Motor & Accessory Manufacturers' Association. It will be the first of many similar groups to be formed within the M. A. M. A. and the decision to dissolve will be followed by several other organizations of manufacturers engaged in the same line. The first group contains some of the leading sheet metal workers in the United States who do an automobile business.

The purpose of the various groups will be to discuss subjects of interest and value to the particular division or branch of the industry in which the members of the group are engaged; to advance and improve the entire industry as well as the particular branch represented; to collect and disseminate statistics and information of value to members; to promote such standardization of mechanical equipment, production methods and commercial practices as may be deemed desirable; to promote a spirit of friendly aid and co-operation within the groups and also with other groups in the industry. It is believed such co-ordination of effort by manufacturers with practically identical interests will largely increase the value of the M. A. M. A.

The affairs of the sheet metal group will be directed by an executive committee headed by H. P. Carrow.

WILMINGTON ADDS EQUIPMENT

WILMINGTON, DEL., July 2 — The directors of the department of Public Safety will soon place orders for about $108,000 worth of motorized fire equipment. The department, which was recently created, expects to take over the bulk of the equipment of the volunteer fire department, in connection with the proposed new paid department, which will be under its care after Sept. 1. The local equipment to be bought is valued at about $115,000, but it is not enough, hence the desire for additional equipment. The department is having the advice of former Chief Croker.